

A visual comparison of the excavated profile and the GPR signal profile showed a moderate correlation in stratigraphic transitions (Figure 156). Strata Ia to Ic were all clearly observed and occurred near the ground-truthed depths. Two utility pipes were found 0.2 and 0.28 mbs. A void was observed in the profile map and corresponded to the utilities that were found in the same location. No other discrete objects were observed in the GPR results or subsequent excavation.

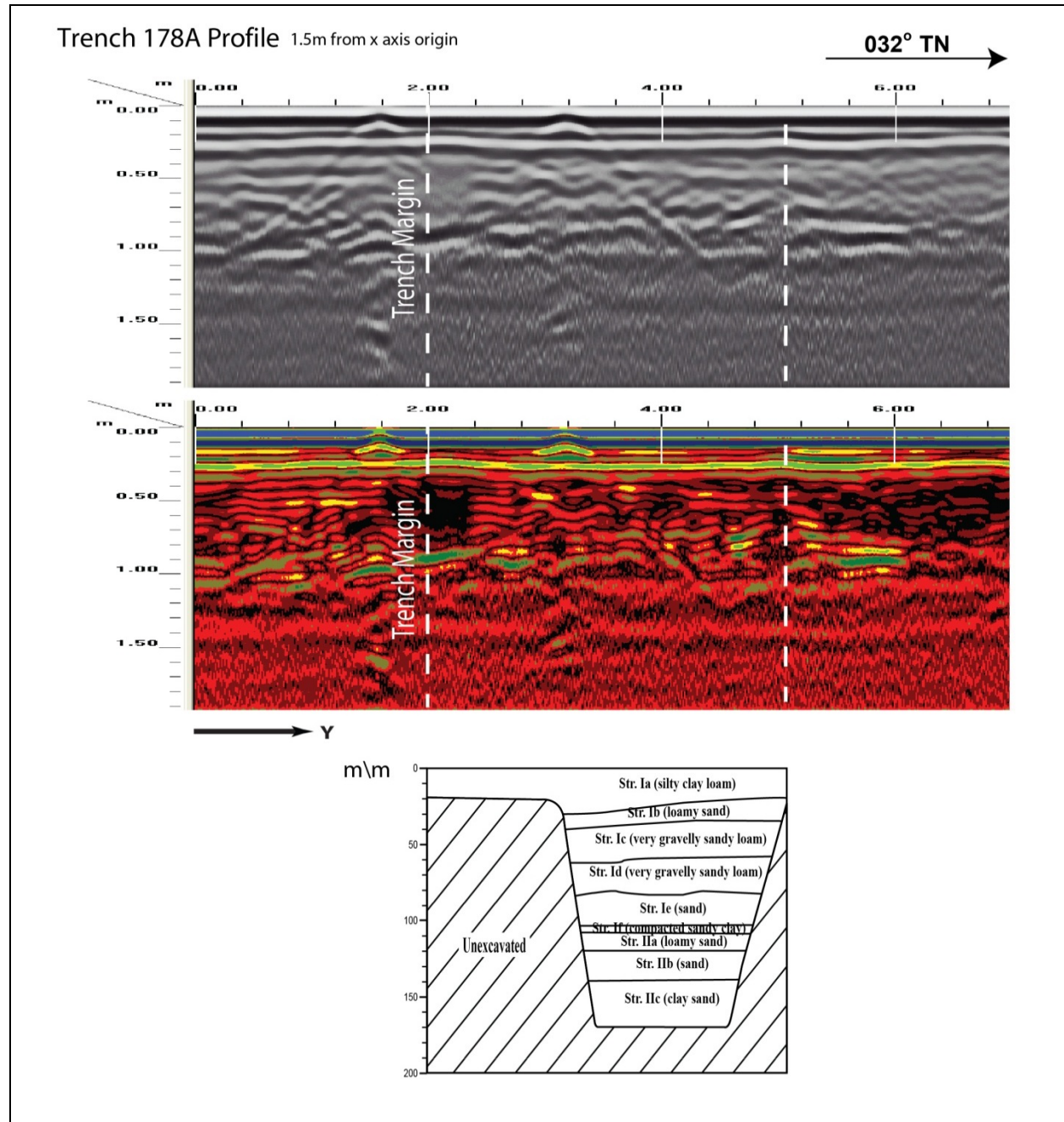


Figure 156. Visual comparison of excavated profile and GPR signal profile of T-178A

## Section 3 East Kaka'ako Geographic Zone (T-179 to T-197)

---

### 3.1 Overall Location

For reporting purposes for this AIS, the City Center Section 4 of the HHCTCP has been divided into 11 zones based on geographical and cultural boundaries. The East Kaka'ako Geographic Zone extends from Kamake'e and Queen Streets at the west end, through Waimanu and Pensacola Streets, and follows Kona Street to Pi'ikoi Street, which marks the east end (Figure 157). The central portion of this zone was within the historic Kolowalu Fishpond (see Vol. II Figure 48). The East Kaka'ako Zone corridor was located entirely within Honolulu Ahupua'a. Pi'ikoi Street marks the *ahupua'a* boundary between Honolulu and Waikiki Ahupua'a.

The East Kaka'ako Zone includes 19 AIS Test Excavations numbered T-179 through T-197 (Note: T-197 was abandoned because it was located in an existing building; however, T-196 was placed in the immediate vicinity of T-197, between the straddle-bent columns and within the utility relocation corridor, and appropriate information was collected from this area). Test excavations were generally numbered from west to east. The Test Excavations within the East Kaka'ako Zone were located within TMKs [1] 2-3-004 (Waimanu Street, owned by the City and County of Honolulu), [1] 2-3-004:080 and [1] 2-3-004:054 (Queen Street, owned by the Hawaii Community Development Authority), [1] 2-3-004:069 (Queen Street, owned by Cody Properties LLC), [1] 2-3-007 (Pensacola Street and Kona Street, owned by the City and County of Honolulu), [1] 2-3-007:033 (Kona Street and Pensacola Street, owned by Kakaako Associates LLC) and [1] 2-3-007:054 (Kona Street, owned by Virginia L. Trust).

### 3.2 Geography, Geology, and Land Forms

The East Kaka'ako Zone was situated within a topographic section of O'ahu called the Honolulu Plain, approximately 0.5 km from the shoreline, in an area generally less than 4.5 m above sea level (Davis 1989:5). Test excavations ranged from 1.3 to 1.8 m amsl. The Honolulu Plain was stratified with late-Pleistocene coral reef substrate overlaid with calcareous marine sand or terrigenous sediments, and stream-fed alluvial deposits (Armstrong 1983:36). As the East Kaka'ako Zone traverses a predominantly urban landscape, vegetation in the immediate vicinity was largely the result of landscaping and consists primarily of introduced (non-indigenous) landscaping trees, shrubs, and ground cover. The average annual rainfall in the East Kaka'ako Zone was approximately 600 mm (23 inches) (Giambelluca et al. 2011).

According to the U.S. Department of Agriculture National Resources Conservation Service Soil Survey Geographic (SSURGO) Database (2001) and soil survey data gathered by Foote et al. (1972), soils within the Kewalo Zone consist exclusively of Fill Land (FL) (Figure 157). Fill Land soils were described as follows:

...areas filled with material dredged from the ocean or hauled from nearby areas, garbage, and general material from other sources.... This land type was used for urban development including airports, housing areas, and industrial facilities. (Foote et al. 1972:31)

### 3.3 Modern Land Use and Built Environment

The East Kaka'ako Zone traverses an urban environment through the neighborhood of Kaka'ako/Kewalo. The centerline of the project alignment within the East Kaka'ako Zone lies within Queen Street and Kona Street, cutting through a current industrial lot bordered by Waimanu, Pensacola and Kona Streets. Parcels bordering the East Kaka'ako Zone corridor contain largely, commercial structures, industrial warehouses, residential high rises and parking lots. Additionally, two construction projects were on-going, one at the east end of the corridor and a second slightly *makai* of the East Kaka'ako Zone Corridor on Waimanu Street, both for residential high rises buildings. A massive utility corridor was also present throughout the East Kaka'ako Zone containing electrical, gas, water, sewer, and storm lines. The number and distribution of these existing utilities indicate that this East Kaka'ako Zone has been heavily disturbed in the past.

### 3.4 GPR Sediment Summary

Test excavations in the East Kaka'ako Geographic Zone (Zone 9) revealed that the area was predominantly Fill Lands (FL) as predicted by the U.S.G.S. Soil survey map of the zone (Figure 157). Naturally deposited sediments encountered in this zone were generally too deep for the GPR to clearly read. The average depth of clean signal return for this area was approximately one m. Test Excavations that contained naturally deposited sediments within the GPR clean signal range were included in Table 3. Naturally deposited sediments within the range of clean GPR signal return for Zone 9. Representative signal texture profiles for Zone 9 were shown in Figure 158. Signal texture profiles were only collected if the signal return was clear and the stratum was at least 0.25 m thick.

Table 3. Naturally deposited sediments within the range of clean GPR signal return for Zone 9

<b>ZONE 9-KAKAAKO EAST (T-179 to T-197)</b>			
<b>TEST EXCAVATION</b>	<b>STRATUM</b>	<b>MATERIAL</b>	<b>STRATUM ORIGIN (cmbs)</b>
186	II	clay loam	1
191	IIA	sandy clay	0.7
191	IIB	clay	1.1

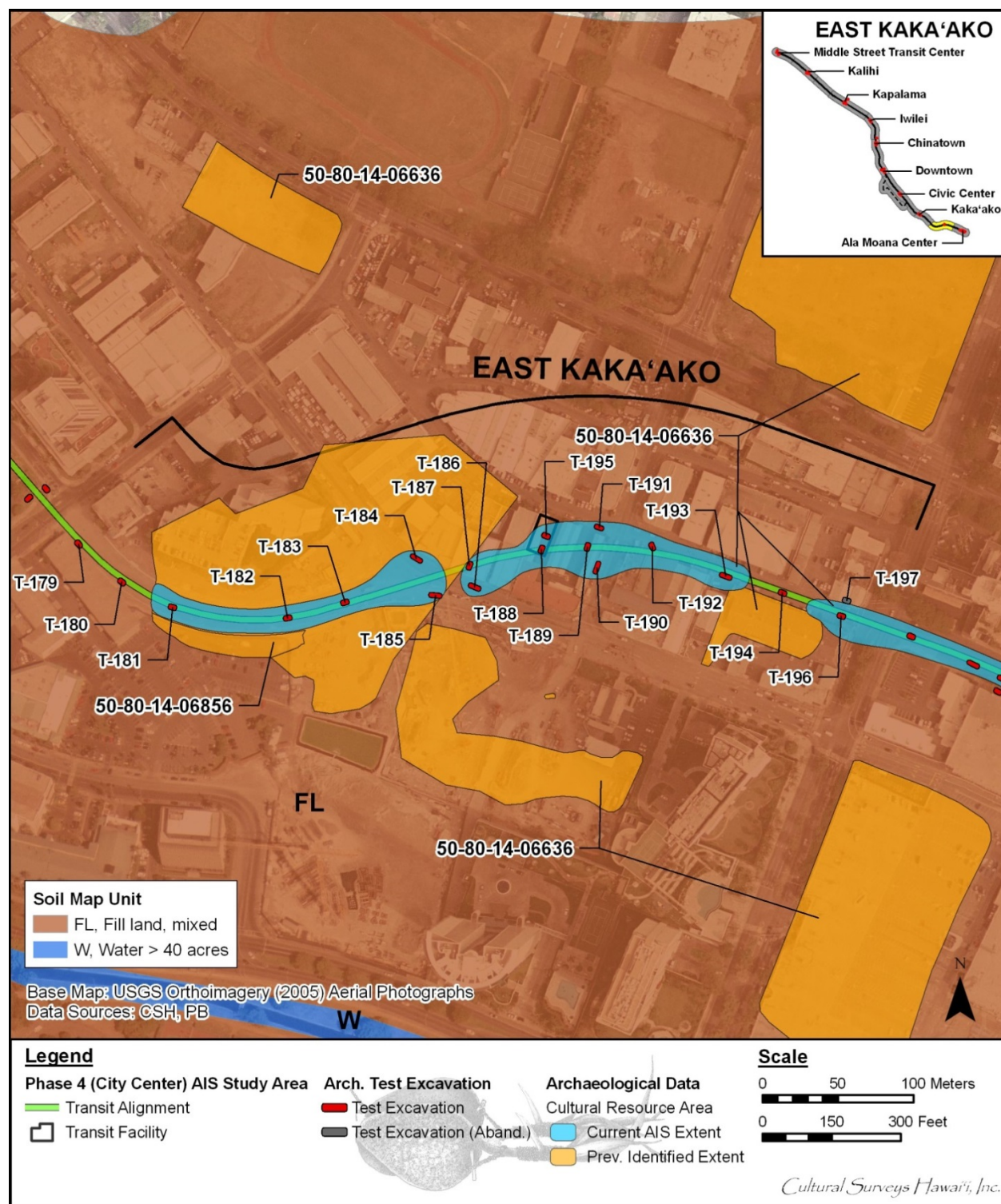


Figure 157. Aerial photograph (source: U.S. Geological Survey Orthoimagery 2005) with overlay of the Soil Survey of Hawai'i (Foote et al. 1972) showing sediment types within and in the vicinity of the East Kaka'ako Zone



### Examples of GPR Signal Textures Representing Zone 9 Sediments

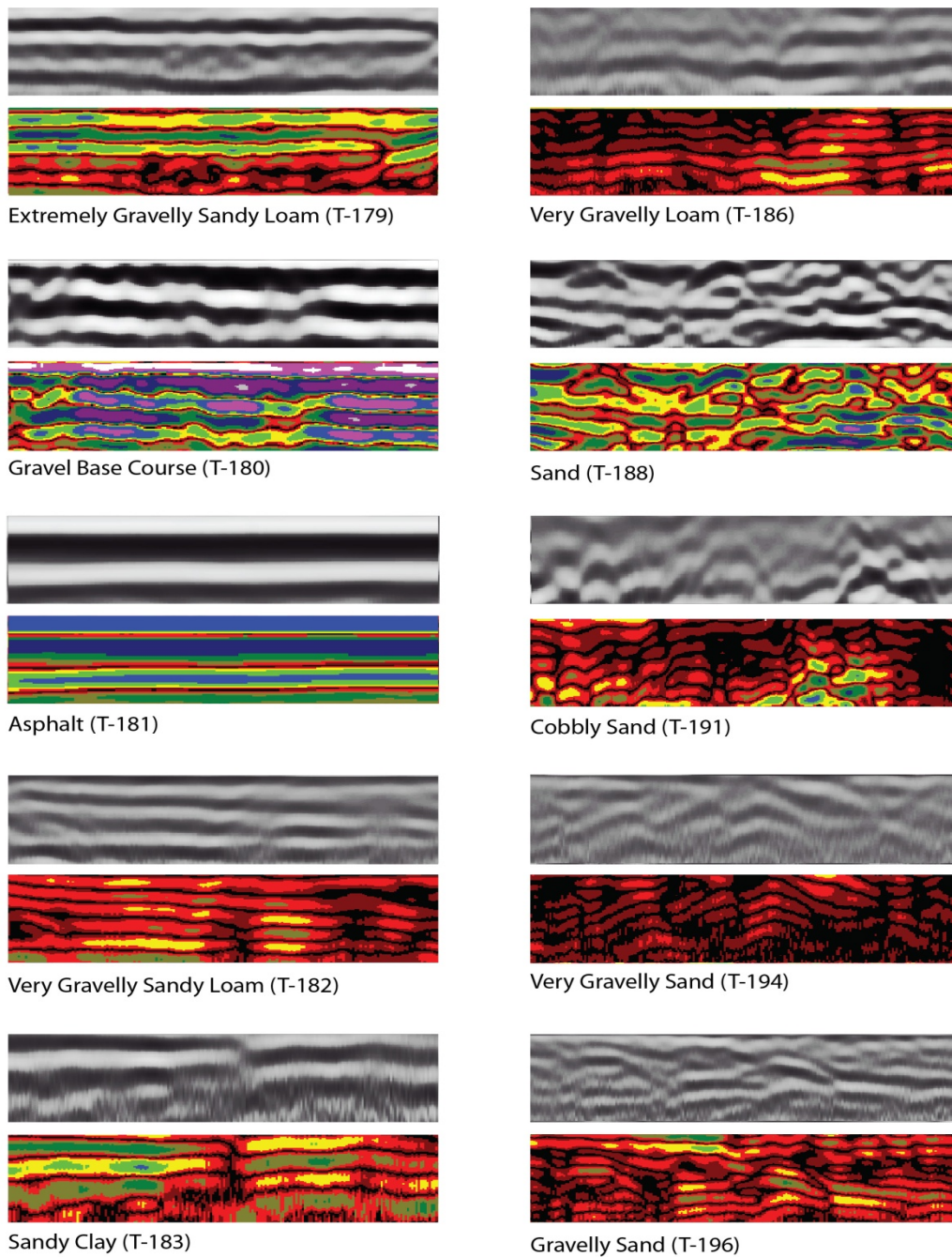


Figure 158. Examples of GPR signal textures representing Zone 9 sediments

## Test Excavation 179

T-179 measured 0.9 m by 3 m and was oriented northwest to southeast and was located within the road cut of Queen Street, 20 m southeast of Queen Street and Kamake'e Street intersection. The GPR grid measured 3 m by 6 m with 25 cm spacing between Y-transects and 1 m spacing between X transects. Utilities located near the excavation include water drain 1.8 m northwest, water line 1.9 m northeast. No utilities transected the excavation location.

A review of amplitude slice maps indicated a linear feature but was not encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth except for the linear feature. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.75 mbs (Figure 159).

GPR depth profiles for T-179 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 160). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.4 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 1.0 mbs.

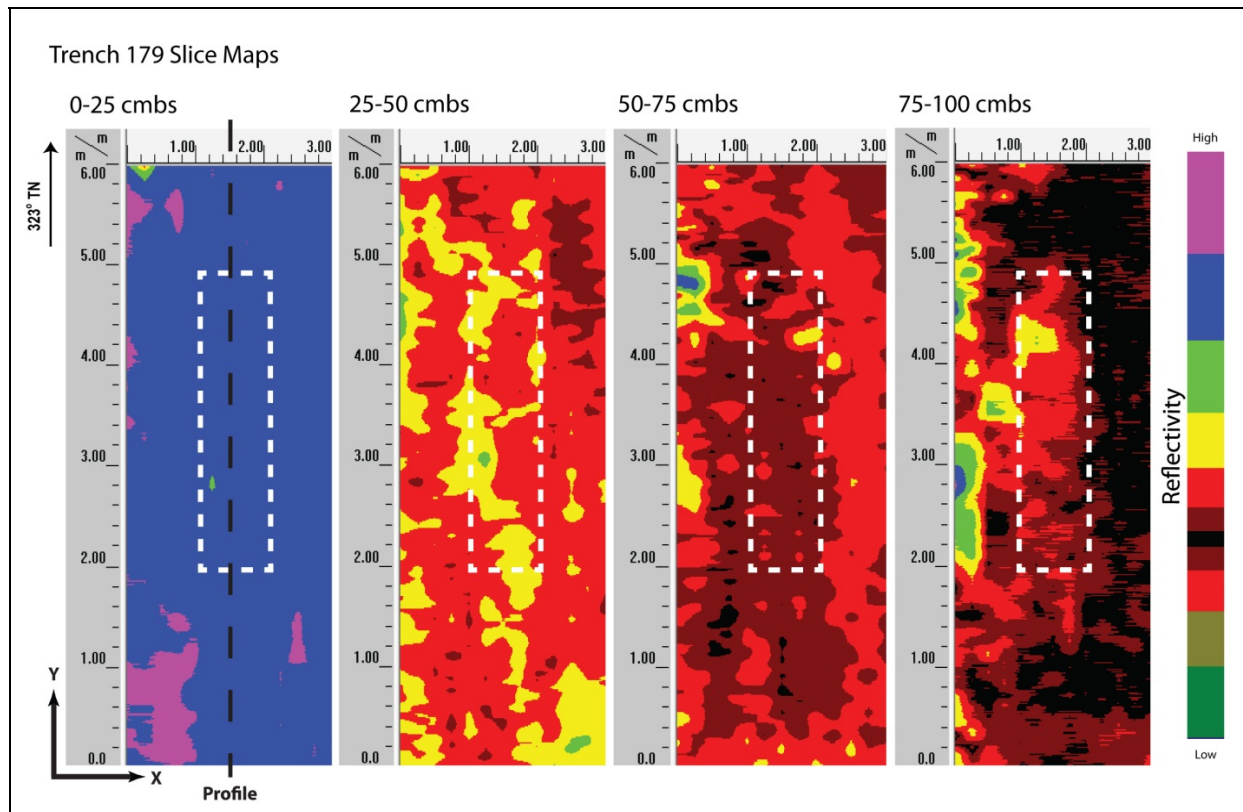


Figure 159. Slice maps of T-179 at 25 cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a moderate correlation in stratigraphic transitions (Figure 160). Strata Ia and Ib were all clearly observed and occurred near the ground-truthed depths. A stratigraphic transition was observed around 0.45 mbs and may represent cobbles located near this depth. No discrete objects were observed in the GPR results or subsequent excavation.

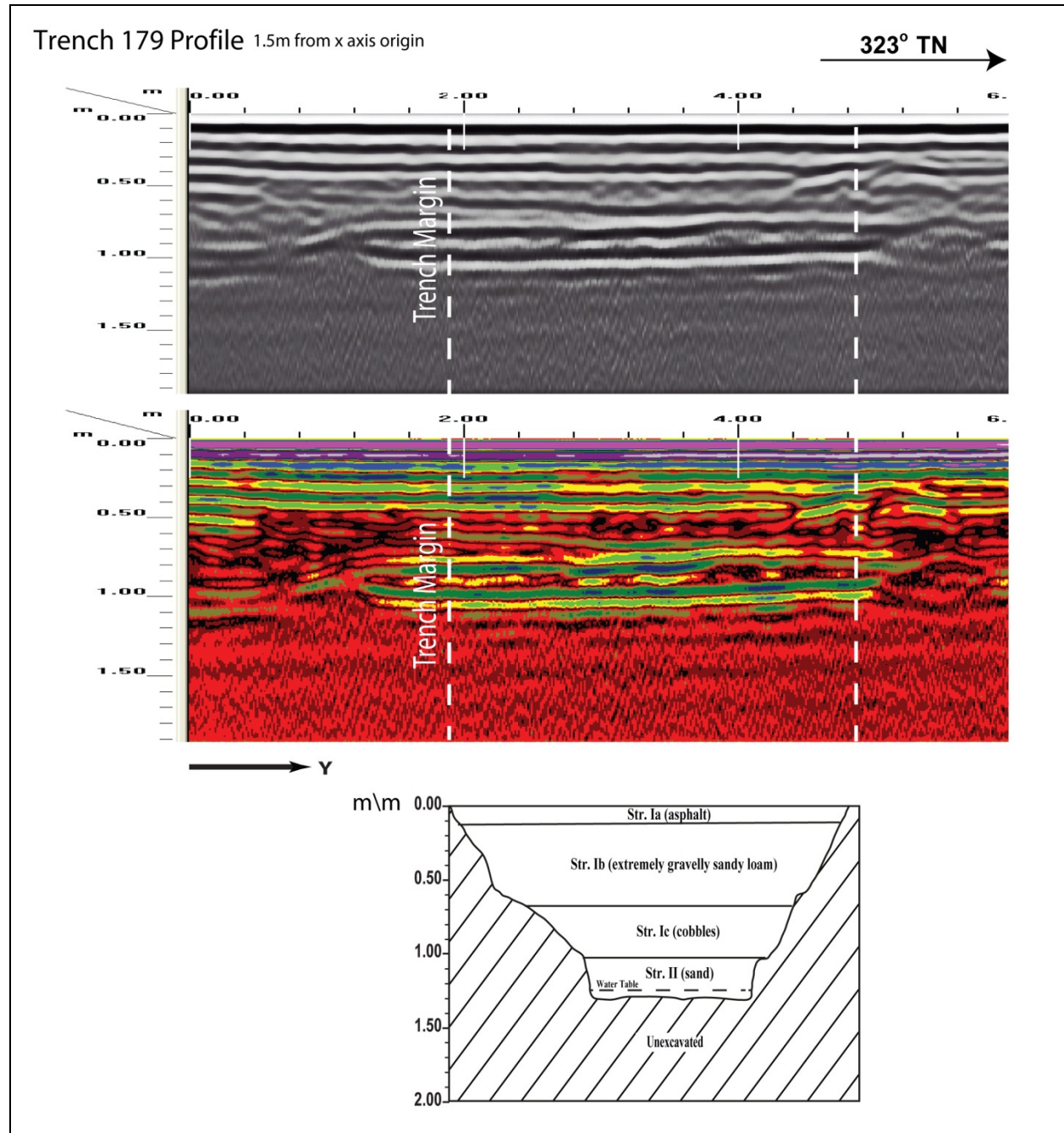


Figure 160. Visual comparison of excavated profile and GPR signal profile of T-179



## Test Excavation 180

T-180 measured 0.9 m by 3 m and was oriented northwest to southeast and was located within the road cut of Queen Street, 55 m southeast of Queen Street and Kamake'e Street intersection. The GPR grid measured 3 m by 6 m with 25 cm spacing between Y-transects and 1 m spacing between X-transects. Utilitied located near the excavation include water line less than 1 m northeast, water drain running through northwest end of excavation. No utilities transected the excavtion location.

A review of amplitude slice maps indicated no linear features which might indicate the presence of utilities. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.75 mbs (Figure 161).

GPR depth profiles for T-180 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 162). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.6 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 0.9 mbs.

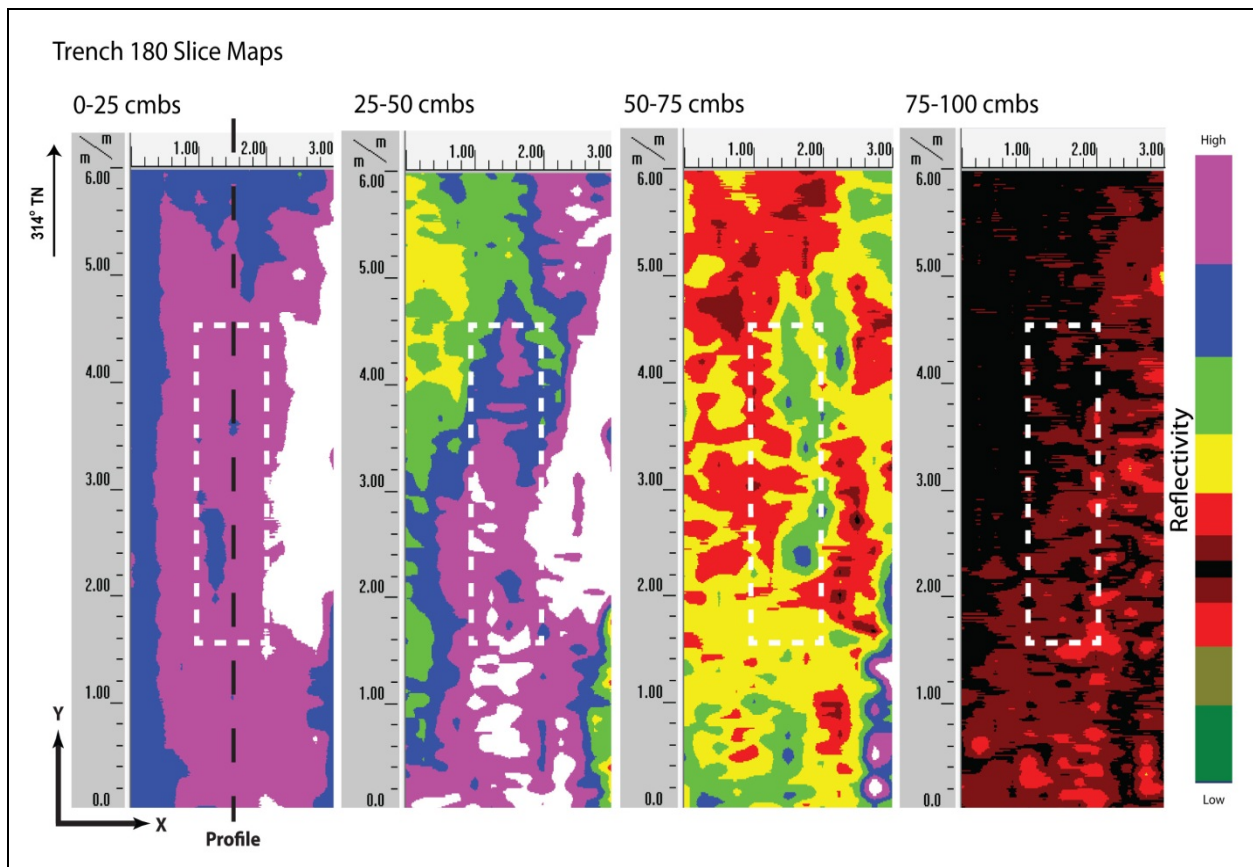


Figure 161. Slice maps of T-180 at 25 cm depth intervals



A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 162). Strata Ia through Ie were clearly observed and occurred at the ground-truthed depths. All other sediment transitions were below the maximum clean signal return depth. No discrete objects were observed in the GPR results or subsequent excavation.

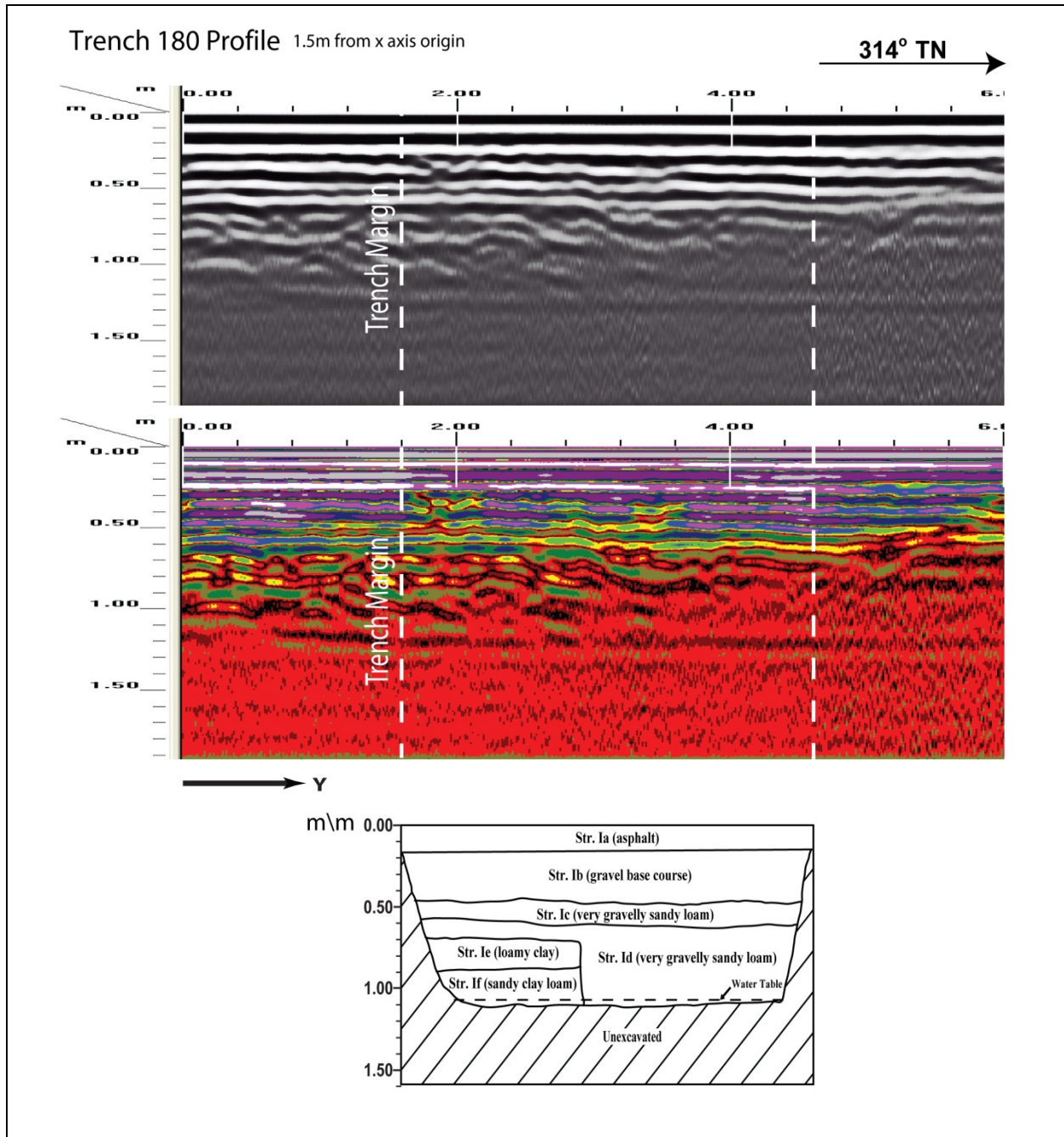


Figure 162. Visual comparison of excavated profile and GPR signal profile of T-180

## Test Excavation 181

T-181 measured 0.9 m by 3 m and was oriented northwest to southeast and was located within the road cut of Queen Street, 90 m southeast of Kamake'e Street and Queen Street intersection. The GPR grid measured 2 m by 5 m with 25 cm spacing between Y-transects and 1 m spacing between X-transects. Utilities located near the excavation include water line 2.2 m south, electrical line 4.1 m south. An irrigation line was encountered 0.7 mbs along the northeast wall of the excavation

A review of amplitude slice maps indicated a linear feature but it was not encountered during excavation but an irrigation line was encountered below the clean signal return. Reflectivity was relatively uniform throughout the grid and decreased with depth except for the linear feature. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.25 mbs and increases again around 0.75 mbs (Figure 163).

GPR depth profiles for T-181 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 164). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.3 mbs. An anomaly was observed in the profile but was not encountered during excavation but an irrigation line was encountered. The maximum depth of clean signal return was approximately 1.1 mbs.

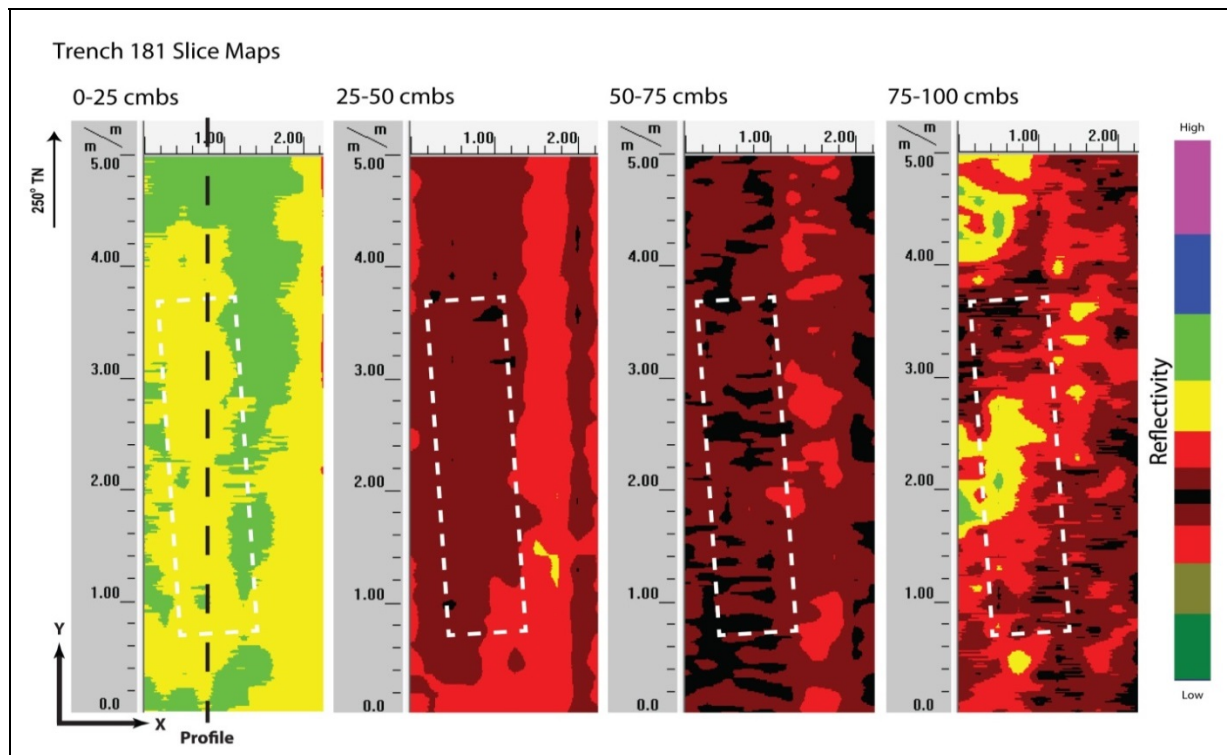


Figure 163. Slice maps of T-181 at 25 cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 164). Strata Ia to Ic were clearly observed and occurred near the ground-truthed depths. Strata included, from top to bottom, asphalt, extremely gravelly clay loam fill, cobbly sand fill, sandy clay fill, and natural sandy clay. No discrete objects or other stratigraphic transitions were observed in the GPR results or subsequent excavation.

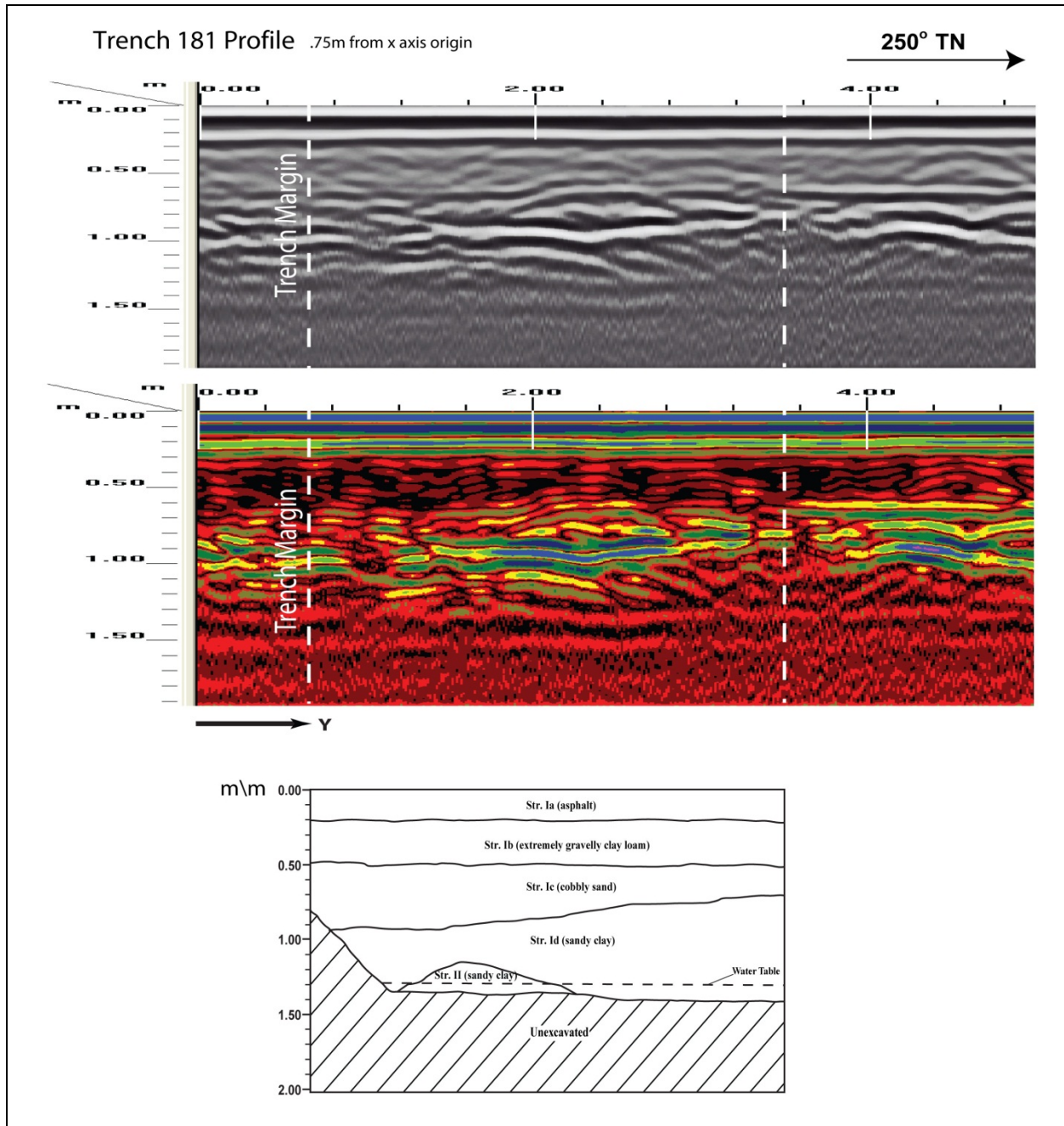


Figure 164. Visual comparison of excavated profile and GPR signal profile of T-181



## Test Excavation 182

T-182 measured 0.9 m by 3 m and was oriented northeast to southwest and was located within the road cut of Queen Street, 75 m southwest of Queen Street and Waimanu Street intersection. The GPR grid measured 2 m by 5 m with 25 cm spacing between Y-transects and 1 m spacing between X-transects. Utilities located near the excavation include water line 3.1 m south, water drain 4.5 m east. A utility jacket was encountered 0.2 mbs in the eastern end of the excavation.

A review of amplitude slice maps indicated no linear features although a concrete utility jacket was encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.5 mbs (Figure 165).

GPR depth profiles for T-182 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 166). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.3 mbs. An anomaly was observed in the profile which corresponded to the utility jacket encountered during excavation. The maximum depth of clean signal return was approximately 1.0 mbs.

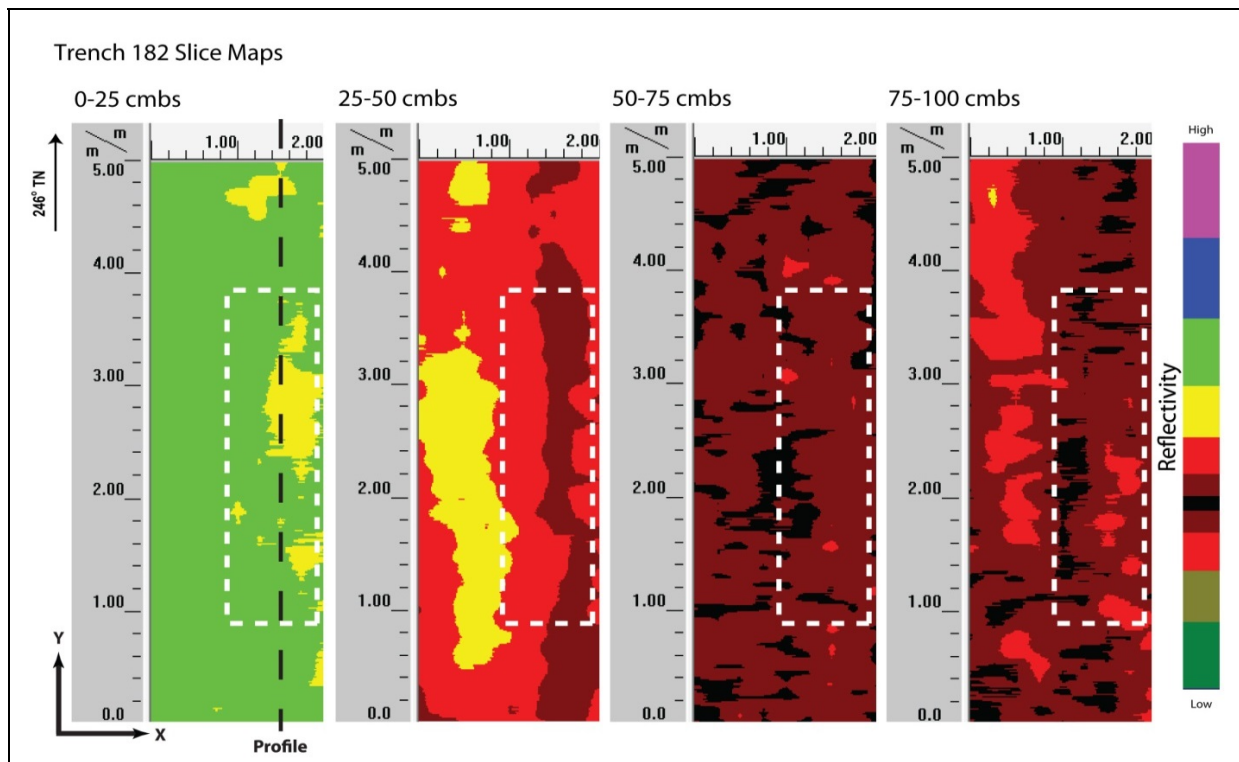


Figure 165. Slice maps of T-182 at 25 cm depth intervals



A visual comparison of the excavated profile and the GPR signal profile showed a moderate correlation in stratigraphic transitions (Figure 166). Strata Ia and Ib were clearly observed and occurred near the ground-truthed depths. The transition to Stratum Ic was not clearly observed and does not occur near the ground-truthed depth. A utility jacket was found 0.2 mbs. A void was observed in the profile and corresponded to the location the jacket was found. No other discrete objects were observed in the GPR results or subsequent excavation.

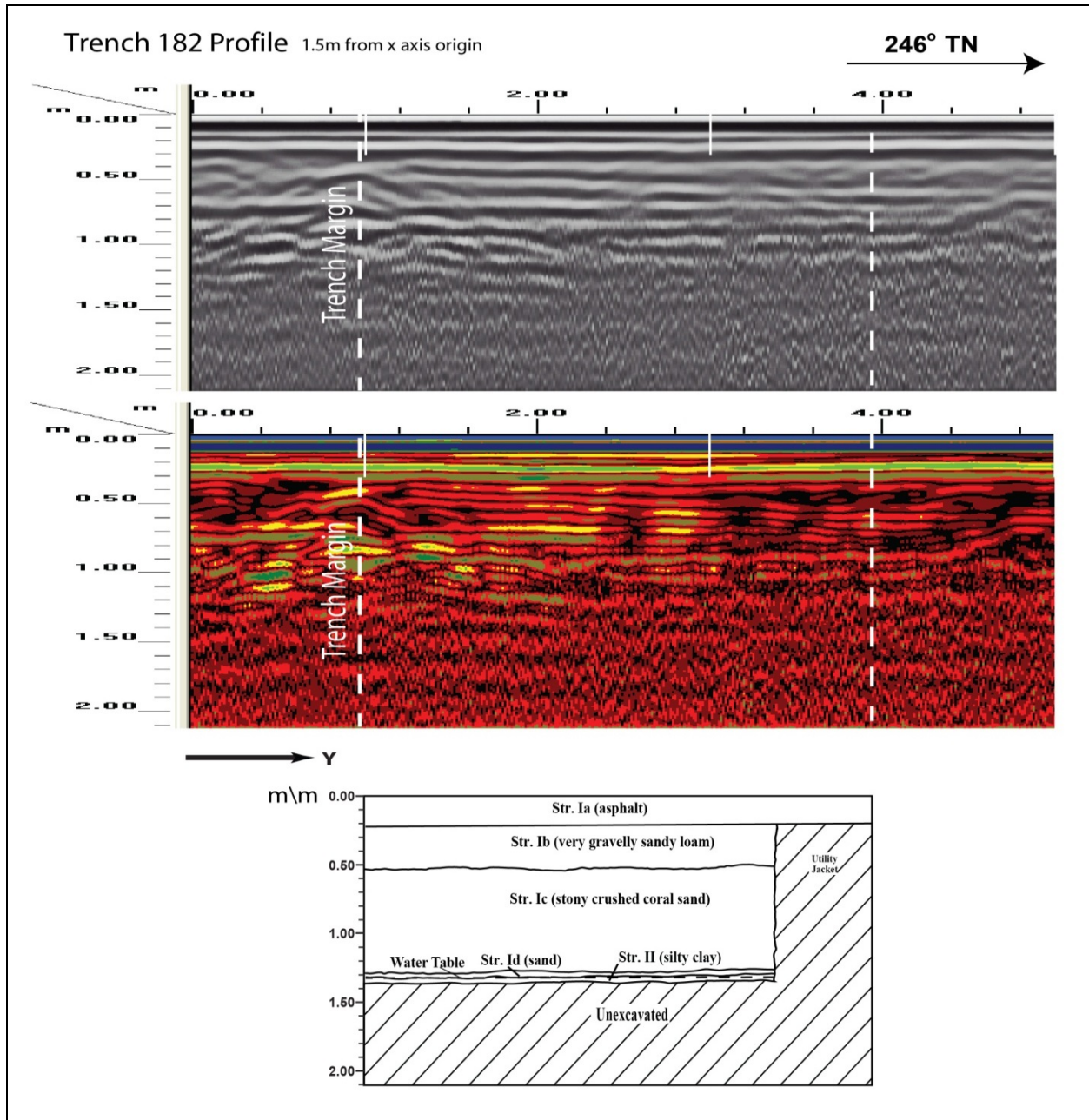


Figure 166. Visual comparison of excavated profile and GPR signal profile of T-182

## Test Excavation 183

T-183 measured 0.9 m by 3 m and was oriented northeast to southwest and was located within the road cut of Queen Street, 35 m southwest of Queen Street and Waimanu Street intersection. The GPR grid measured 2.5 m by 8 m with 25 cm spacing between Y-transects and 1 m spacing between X-transects. Utilities located near the excavation include water line 1.8 m south, electrical line 4.2 m south. Several utility pipes were encountered approximately 0.35 mbs through the entire length of the excavation.

A review of amplitude slice maps indicated no linear features although utilities were encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.5 mbs (Figure 167).

GPR depth profiles for T-183 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 168). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.15 mbs and again around 0.55 mbs. Several anomalies were observed in the profile but not within excavation boundaries and do not corresponded to the utilities encountered during excavation. The maximum depth of clean signal return was approximately 1.0 mbs.

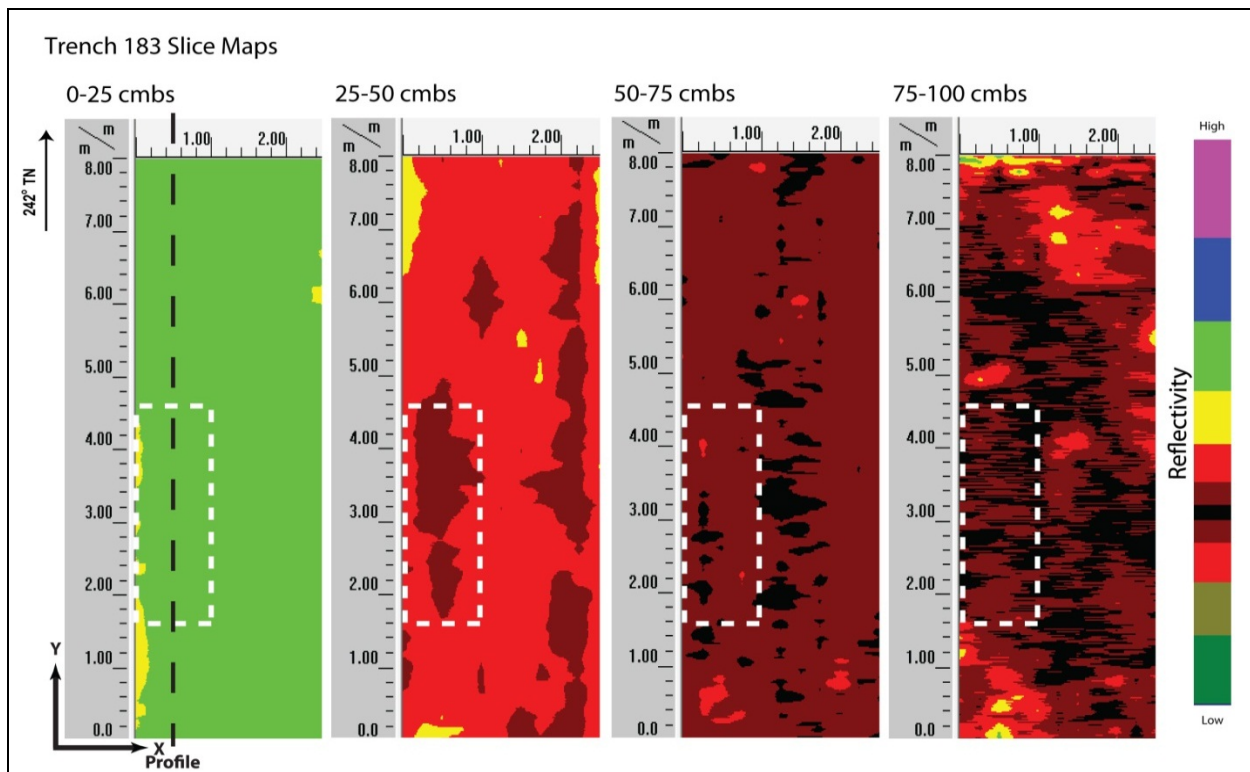


Figure 167. Slice maps of T-183 at 25 cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 168). Strata Ia to Id were clearly observed and occurred at the ground-truthed depths. Several utility pipes were found 0.35 mbs. These pipes did not show up on the profile or slice maps. This may be due to the fact that the pipes were small in diam, empty or that they may have had a similar density to the surrounding stratum. All other sediment transitions were below the clean signal return depth. No other discrete objects were observed in the GPR results or subsequent excavation.

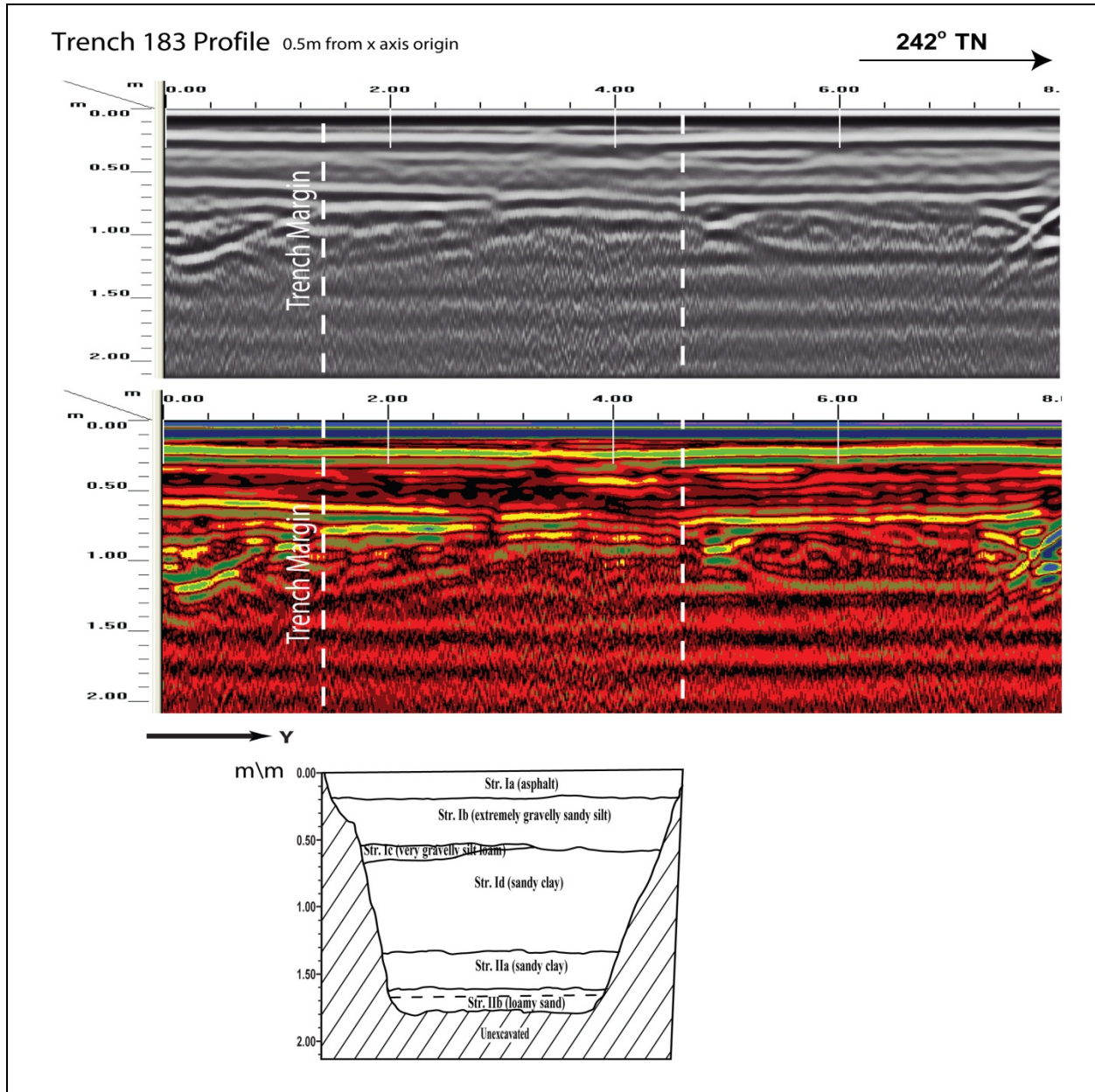


Figure 168. Visual comparison of excavated profile and GPR signal profile of T-183



## Test Excavation 184

T-184 measured 0.9 m by 5 m and was oriented northwest to southeast and was located within a landscaped median on Queen Street, 20 m northeast of Queen Street and Waimanu Street intersection. The GPR grid measured 2.5 m by 8 m with 25 cm spacing between Y-transects and 1 m spacing between X-transects. Utilities located near the excavation include sewer line 7.4 m southwest. A water line was encountered 1.47 mbs paralleling the excavation on the southwest wall.

A review of amplitude slice maps indicated a linear feature but it was not encountered during excavation and a water line was observed but below the clean signal return. Reflectivity was relatively uniform throughout the grid and decreased with depth except for the linear feature. A transition from higher reflectivity to lower reflectivity was observed at approximately 50 mbs and increases again around 0.75 mbs (Figure 169).

GPR depth profiles for T-184 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 170). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.2 mbs. An anomaly was observed in the profile but was not encountered and the water line observed was below the clean signal return. The maximum depth of clean signal return was approximately 0.8 mbs.

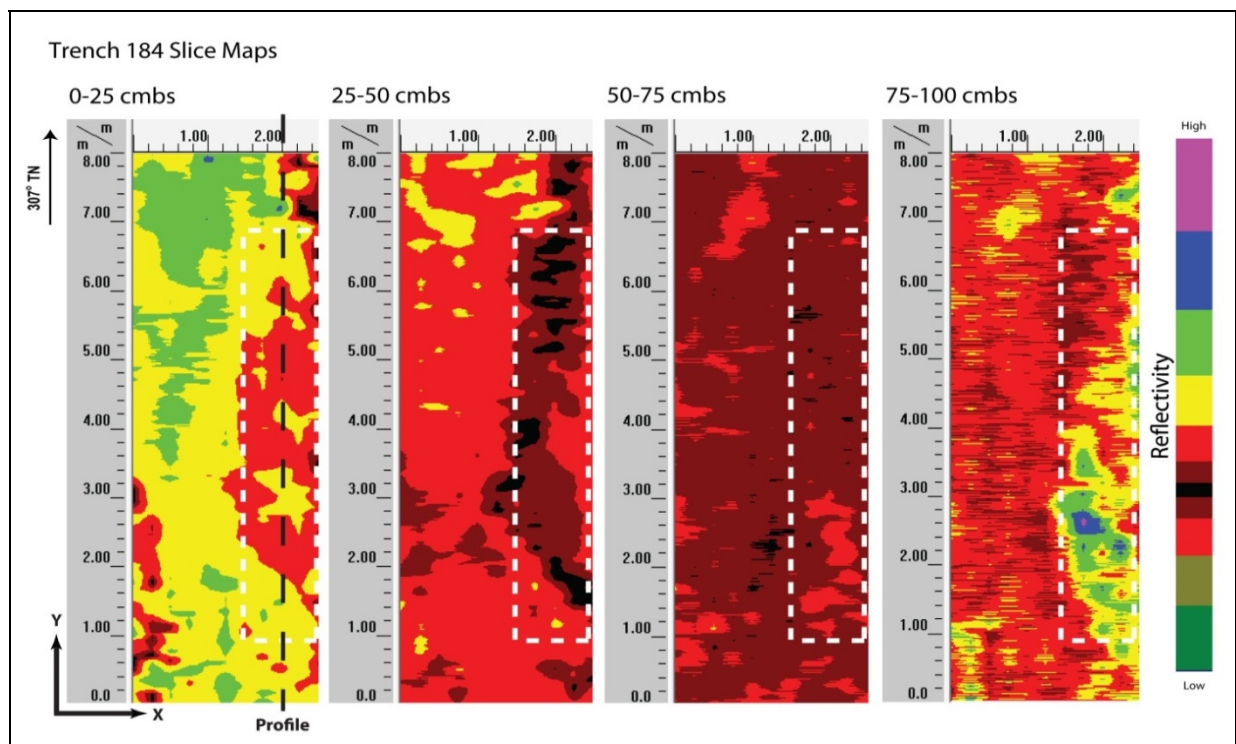


Figure 169. Slice maps of T-184 at 25 cm depth intervals



A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 170). Strata Ia to Ic were clearly observed and occurred at the ground-truthed depths. Strata included, from top to bottom, asphalt, very gravelly sandy loam fill, very gravelly to cobbly sand fill, sandy clay fill, and natural sandy clay. A water line was found 1.47 mbs. This utility did not show up on the profile or slice maps because it was below the maximum clean signal return depth. No other discrete objects or stratigraphic transitions were observed in the GPR results or subsequent excavation.

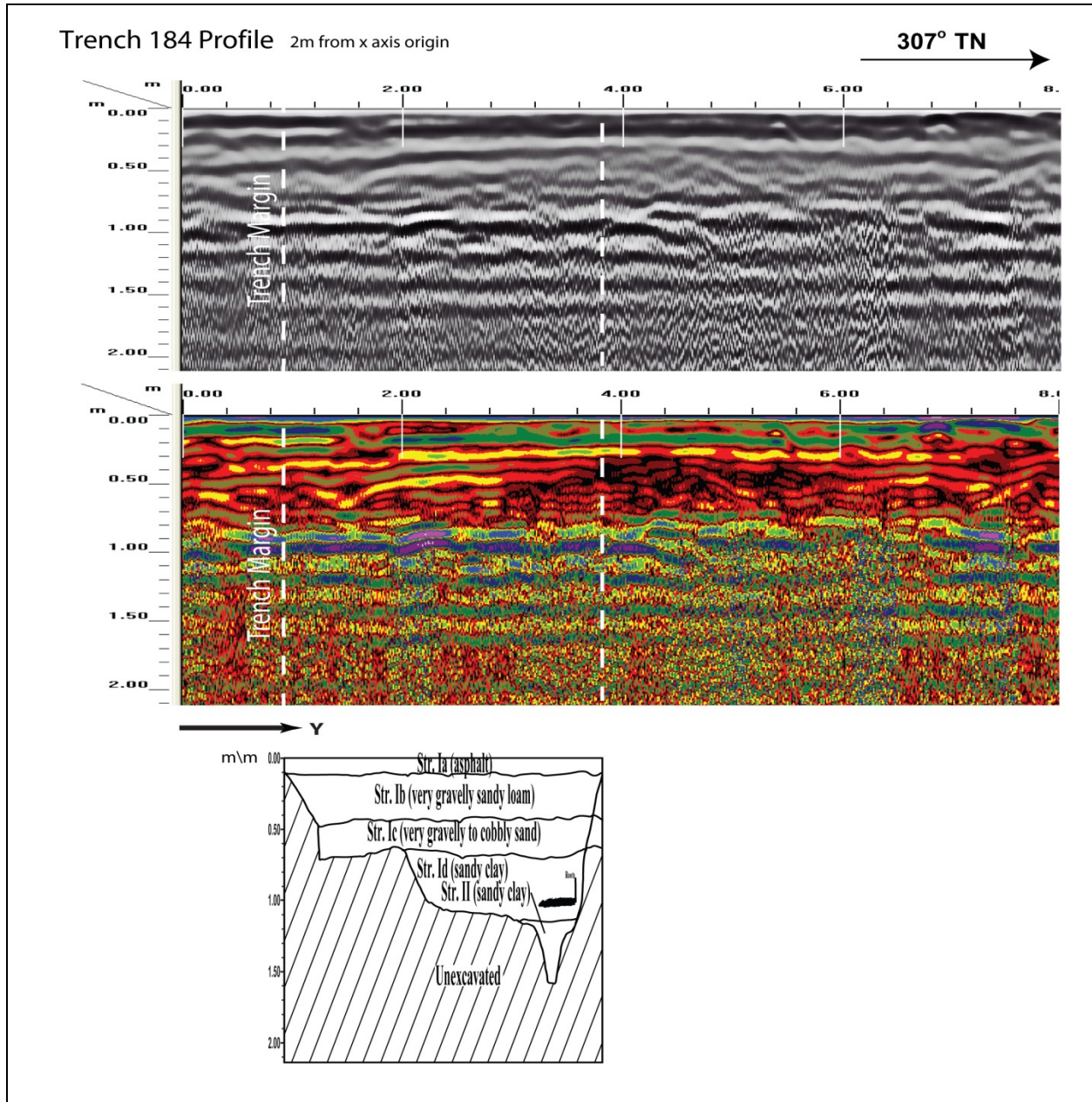


Figure 170. Visual comparison of excavated profile and GPR signal profile of T-184

## Test Excavation 185

T-185 measured 0.6 m by 6 m and was oriented east to west and was located within the road cut of Queen Street, 15 m east of Queen Street and Waimanu Street intersection. The GPR grid measured 3 m by 10 m with 25 cm spacing between Y-transects and 1 m spacing between X-transects. Utilities located near the excavation include electrical line 1.9 m south, sewer line 4.9 m south. No utilities transected the GPR grid or excavation location.

A review of amplitude slice maps indicated no linear features which might indicate the presence of utilities. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.25 mbs (Figure 171).

GPR depth profiles for T-185 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 172). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.3 mbs. An anomaly was observed in the profile and seems to corresponded with a truncated pocket of Stratum Ie. The maximum depth of clean signal return was approximately 1.0 mbs.

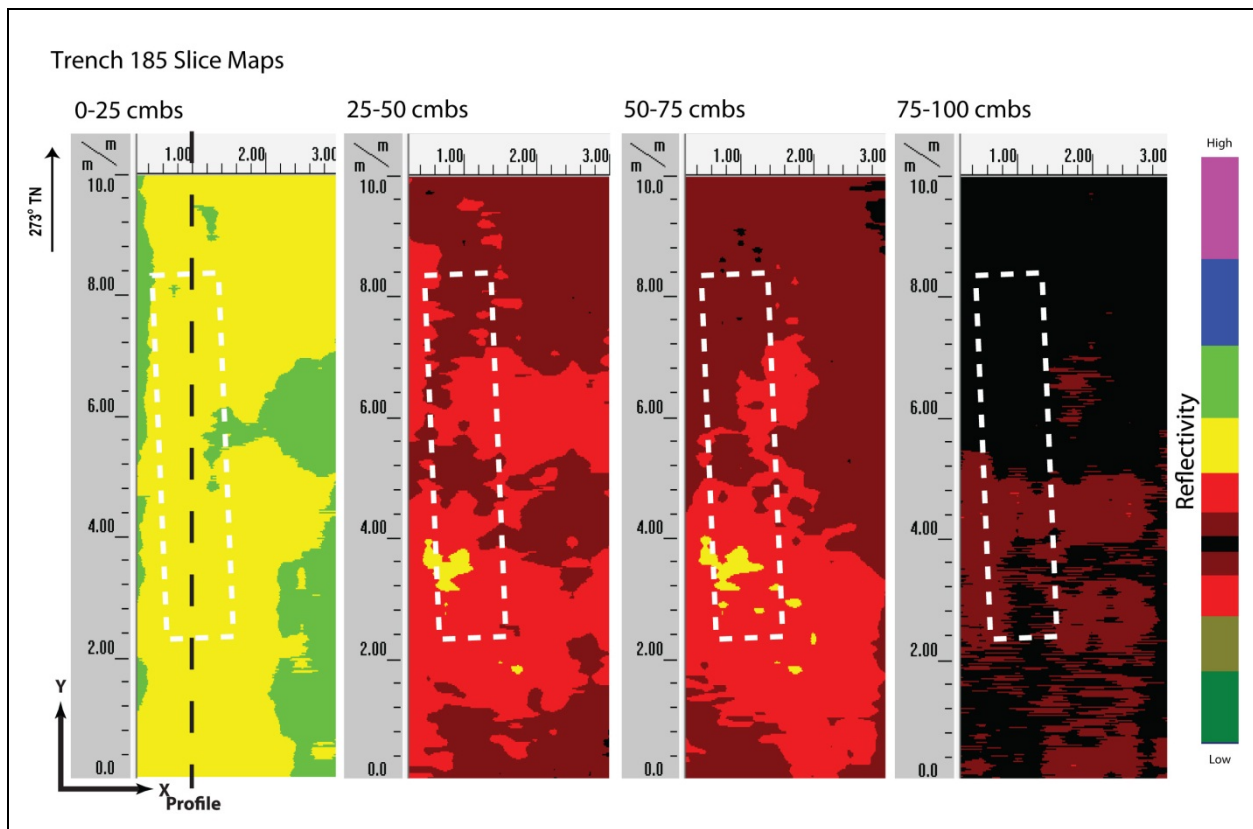


Figure 171. Slice maps of T-185 at 25 cm depth intervals



A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 172). Strata Ia to Ie were clearly observed and occurred at the ground-truthed depths. Strata included, from top to bottom, asphalt, gravel base course, very gravelly base course, gravel, silty loam fill, sandy clay loam fill, and natural gravelly silty loam. No discrete objects or other stratigraphic transitions were observed in the GPR results or subsequent excavation.

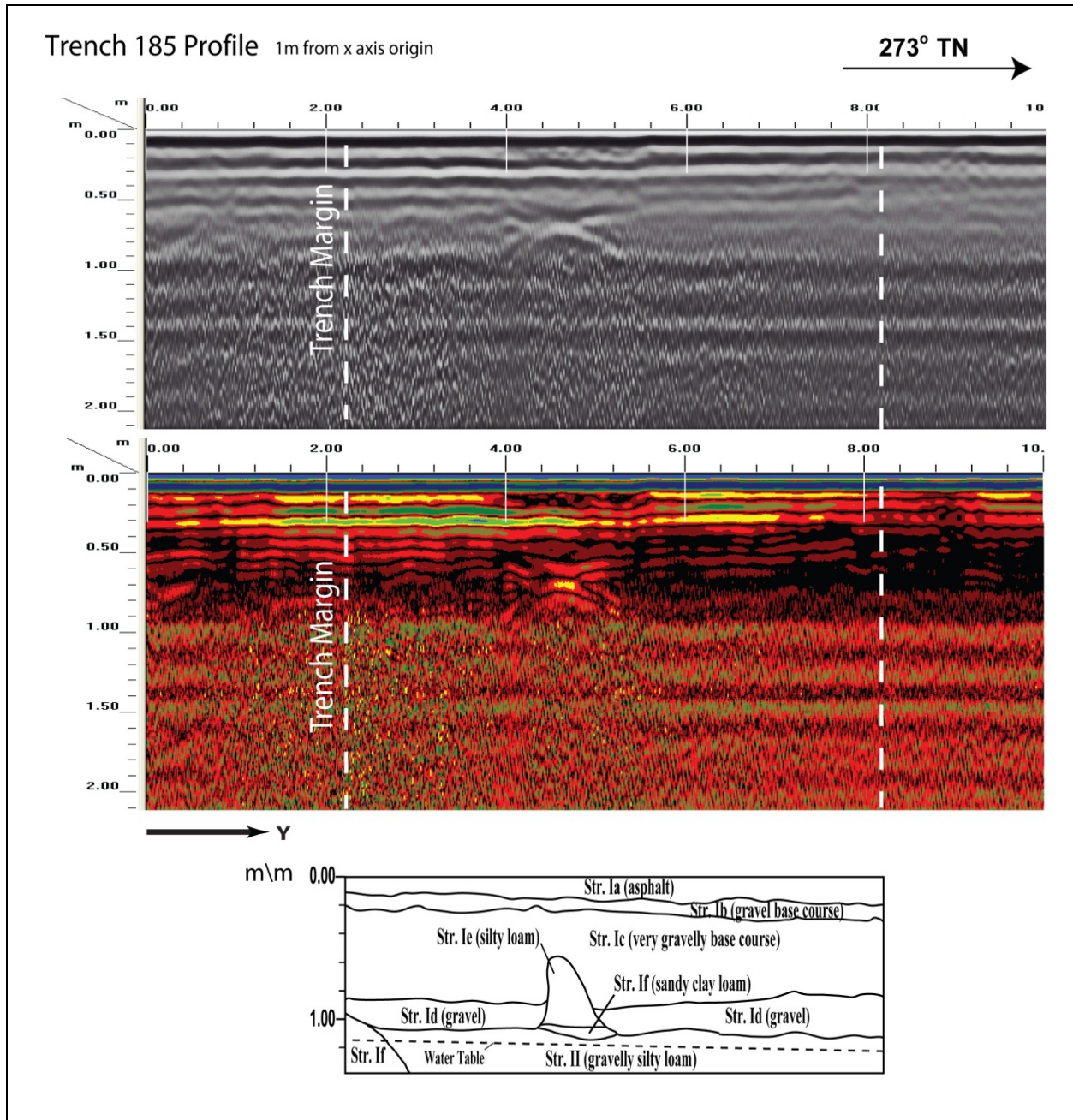


Figure 172. Visual comparison of excavated profile and GPR signal profile of T-185

## Test Excavation 186

T-186 measured 0.6 m by 6 m and was oriented northwest to southeast and was located within the road cut of Waimanu Street, 46 m east of Waimanu Street and Queen Street intersection. The GPR grid measured 2 m by 10 m with 25 cm spacing between Y-transects and 1 m spacing between X-transects. Utilities located near the excavation include sewer line 5.2 m south, water line 7.3 m south. No utilities transected the excavation location.

A review of amplitude slice maps indicated a linear feature but was not encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth except for the linear feature. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.5 mbs (Figure 173).

GPR depth profiles for T-186 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 174). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.15 mbs and again around 1.1 mbs. An anomaly was observed in the profile but was not within excavation boundaries. The maximum depth of clean signal return was approximately 1.1 mbs.

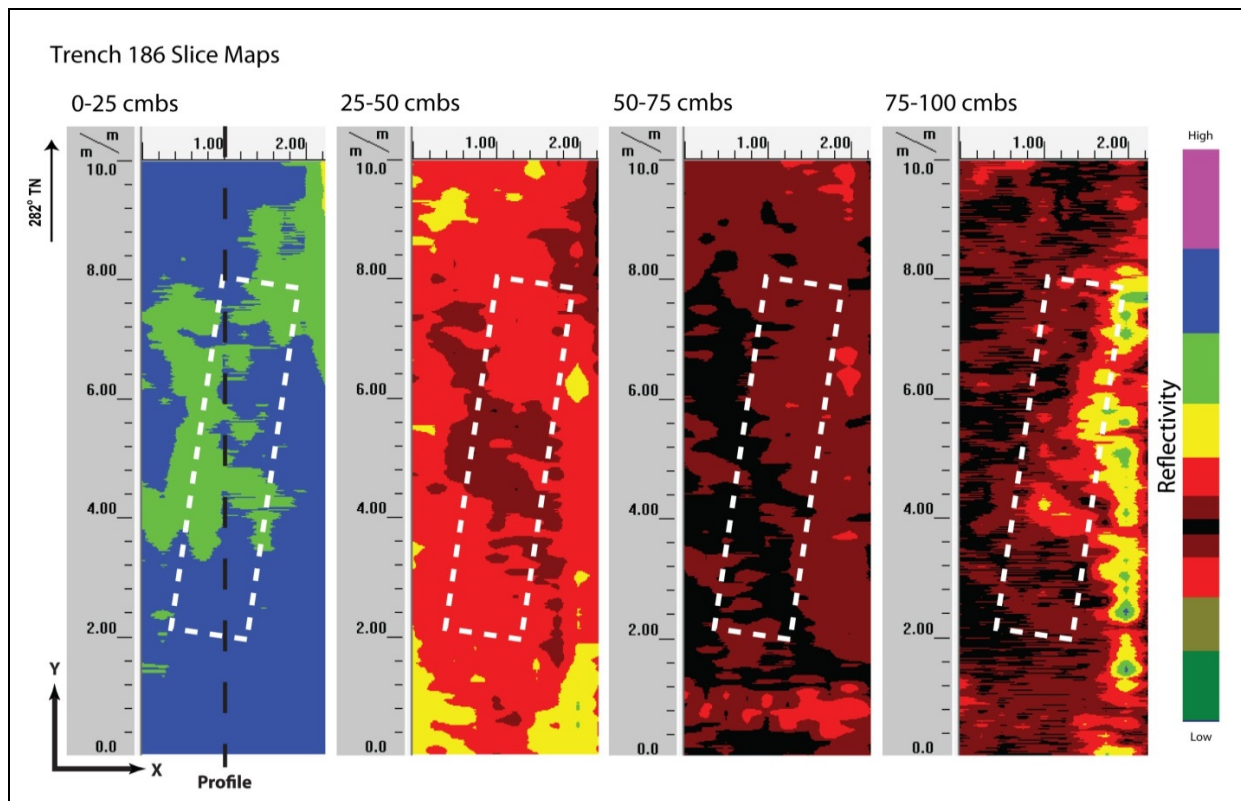


Figure 173. Slice maps of T-186 at 25 cm depth intervals



A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 174). Strata Ia to IIa were clearly observed and occurred at the ground-truthed depths. Strata included, from top to bottom, asphalt, very gravelly loam fill, crushed coral sand, silty clay fill, natural clay loam, natural sandy clay loam, and natural loamy sand. No discrete objects or other stratigraphic transitions were observed in the GPR results or subsequent excavation.

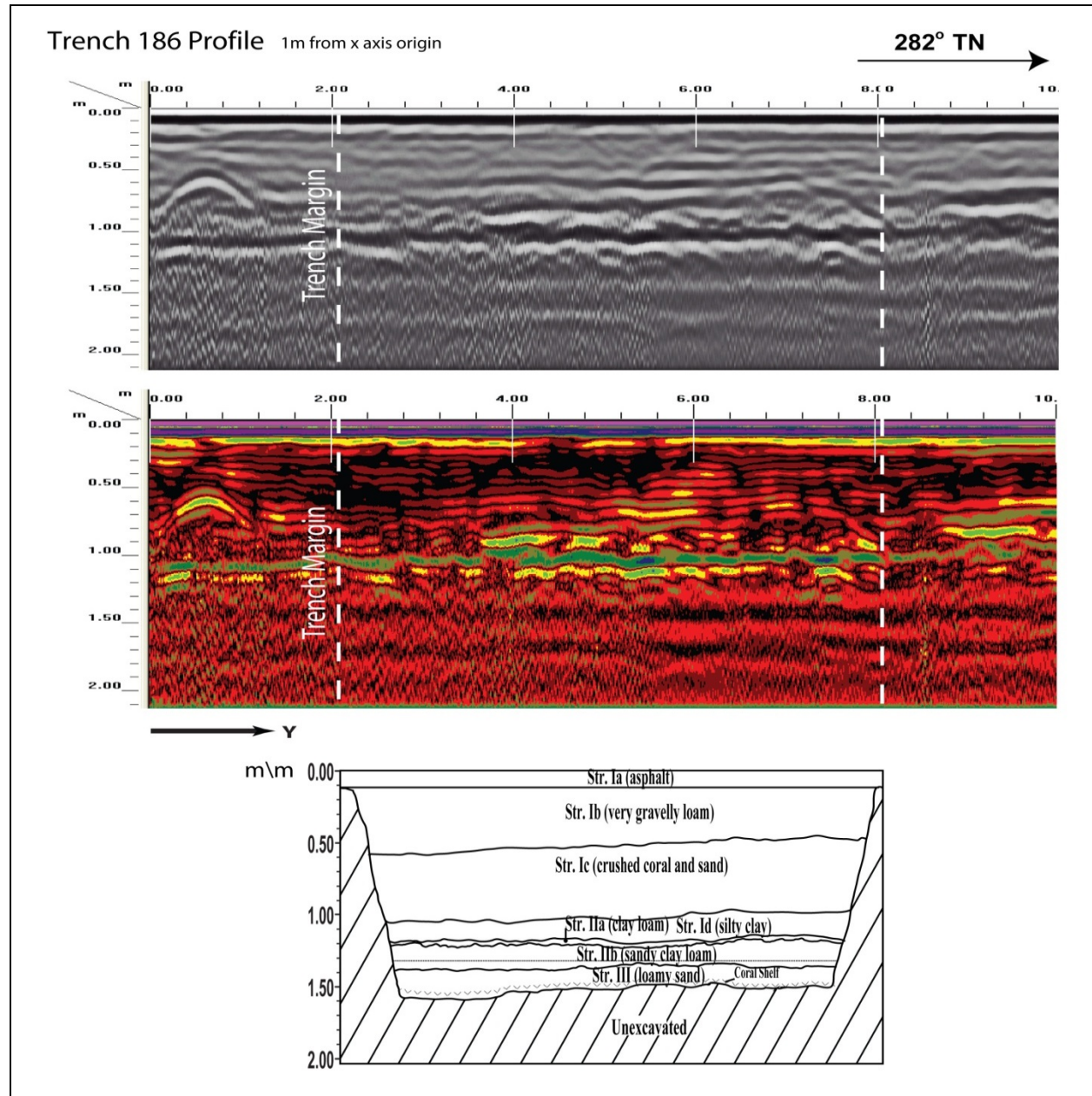


Figure 174. Visual comparison of excavated profile and GPR signal profile of T-186

## Test Excavation 187

T-187 measured 0.9 m by 3 m and was oriented northeast to southwest and was located within a building, 45 m northeast of Waimanu Street and Queen Street intersection. The GPR grid measured 2.5 m by 6 m with 25 cm spacing between Y-transects and 1 m spacing between X-transects. According to PB CADD, there were no utilities within close proximity of the excavation. No utilities transected the GPR grid or excavation location.

A review of amplitude slice maps indicated no linear features which might indicate the presence of utilities. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.5 mbs but increases again around 0.75 mbs (Figure 175).

GPR depth profiles for T-187 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 176). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.25 mbs. An anomaly was observed in the profile but was not encountered during excavation. The maximum depth of clean signal return was approximately 1.0 mbs.

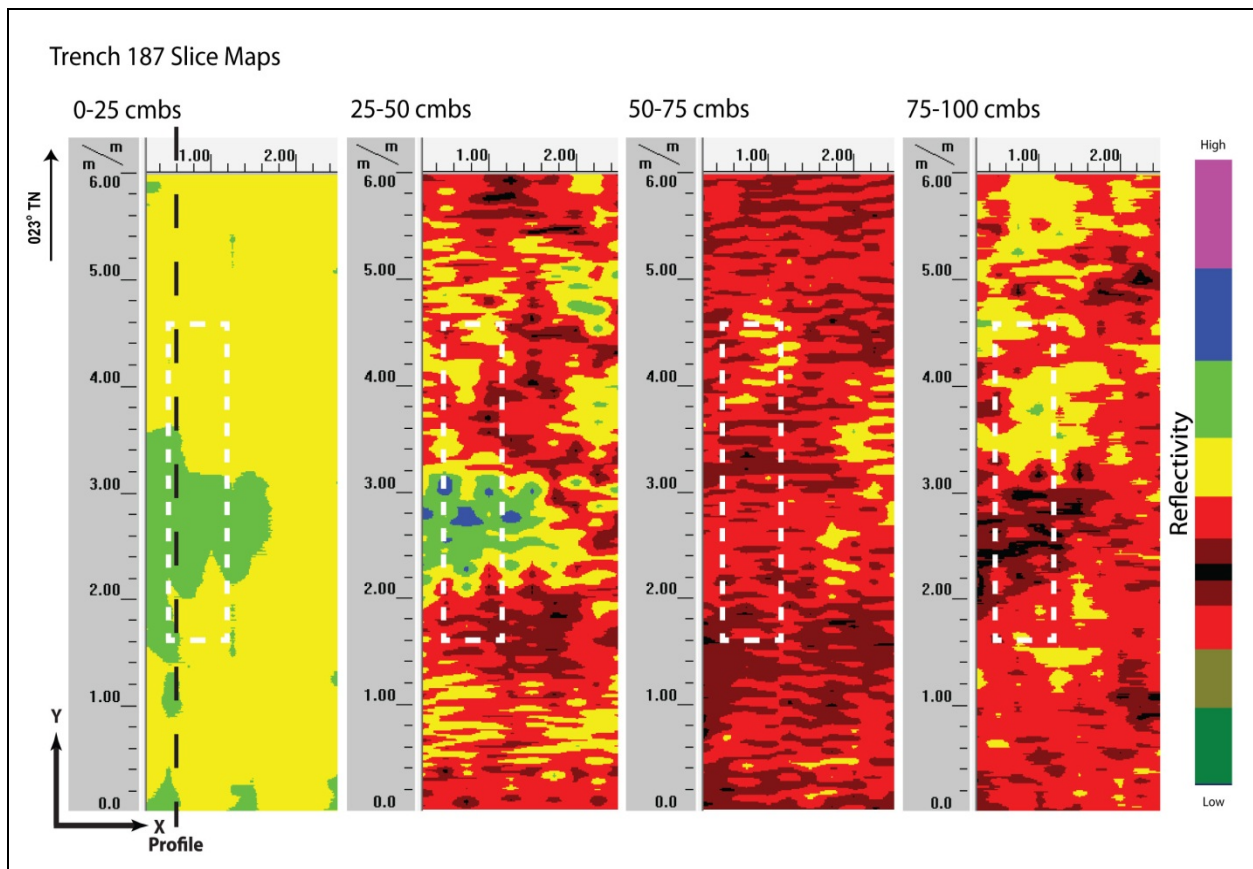


Figure 175. Slice maps of T-187 at 25 cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 176). Strata Ia to IIa were clearly observed and occurred at the ground-truthed depths. Strata included, from top to bottom, concrete, coarse cinder, gravelly to cobbly sand fill, silty clay fill, natural sandy clay, natural sandy loam and natural loamy sand. No discrete objects or other stratigraphic transitions were observed in the GPR results or subsequent excavation.

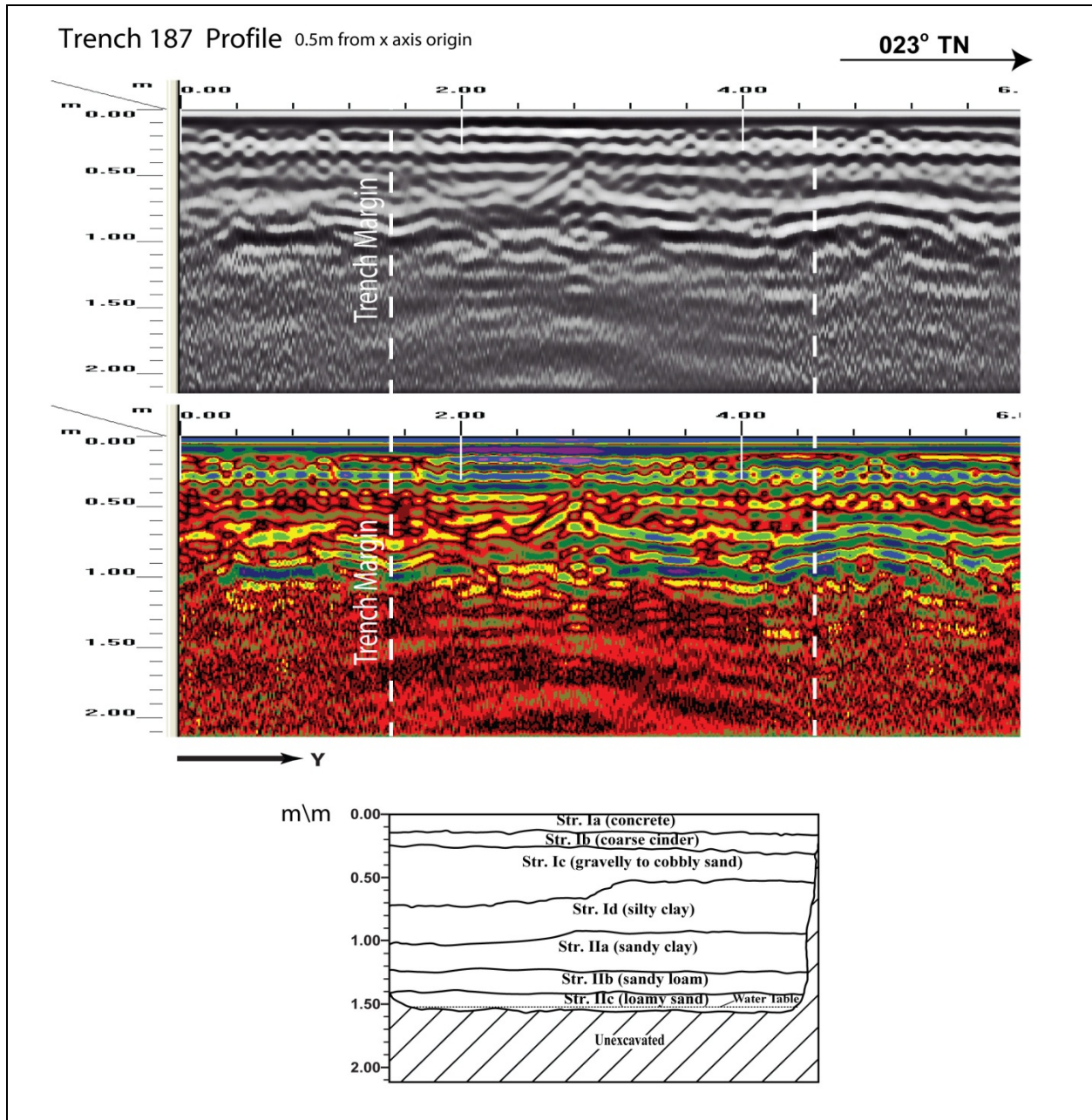


Figure 176. Visual comparison of excavated profile and GPR signal profile of T-187



## Test Excavation 188

T-188 measured 0.9 m by 3 m and was oriented northeast to southwest and was located within a parking lot at Island Pool & Spa Supply, 53 m southwest of Kona Street and Pensacola Street intersection. The GPR grid measured 3 m by 7 m with 25 cm spacing between Y-transects and 1 m spacing between X-transects. According to PB CADD, there were no utilities within close proximity of the excavation. A utility jacket was encountered approximately 0.25 mbs on the southern end of the excavation.

A review of amplitude slice maps indicated linear features but not within excavation boundaries but a utility jacket was encountered during excavation. Reflectivity was relatively uniform throughout the grid and, in this case, seems to increase with depth. A transition from lower reflectivity (0–0.25 mbs) to a higher reflectivity (0.75–1.0 mbs) was evident in this slice map (Figure 177).

GPR depth profiles for T-188 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 178). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.15 mbs and then again around 0.85 mbs. No utilities were observed in the profile although a utility jacket was encountered during excavation. The maximum depth of clean signal return was approximately 1.2 mbs.

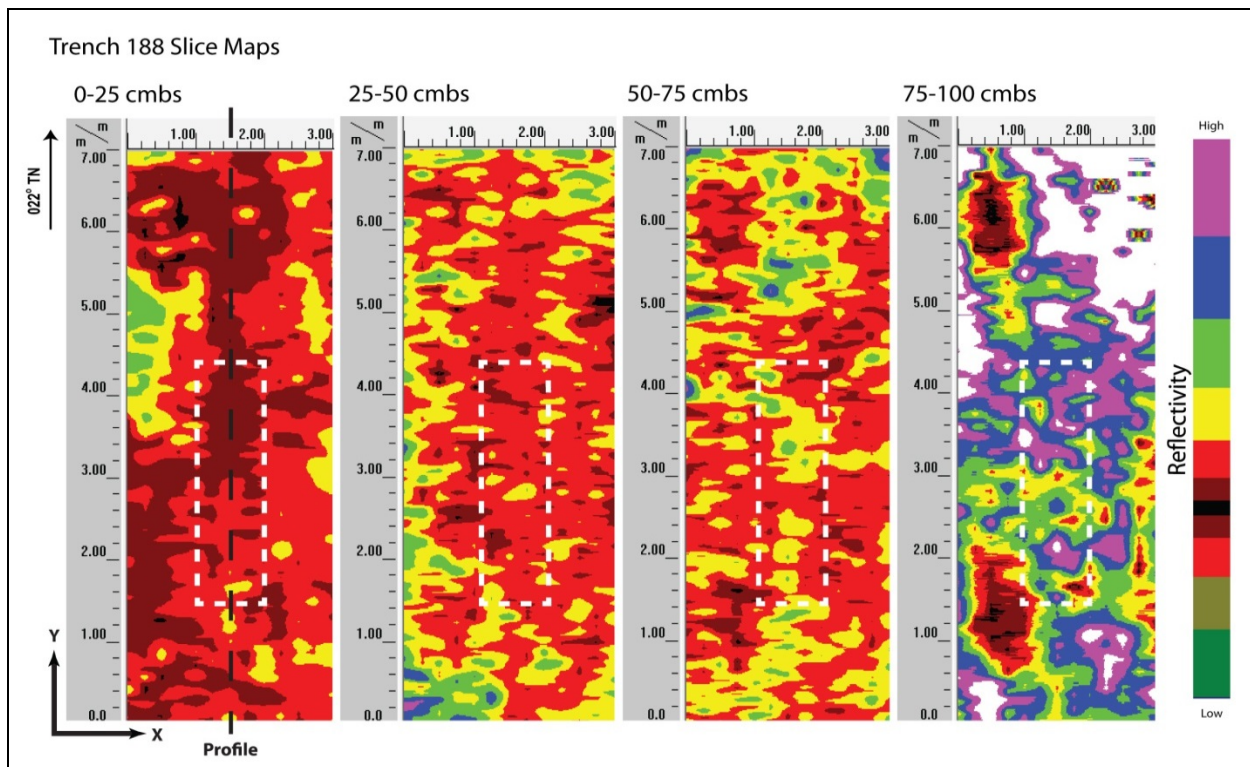


Figure 177. Slice maps of T-188 at 25 cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 178). Strata Ia through Id were clearly observed and occurred at the ground-truthed depths. Textural changes in the form of multiple small hyperbolas were apparent in Stratum Ic which was sand fill. A concrete jacket was found 0.25 mbs. This concrete jacket did not show up on the profile or slice maps. This may be due to the fact that the profile map was highly reflective and an anomaly could be difficult to interpret. No other discrete objects were observed in the GPR results or subsequent excavation.

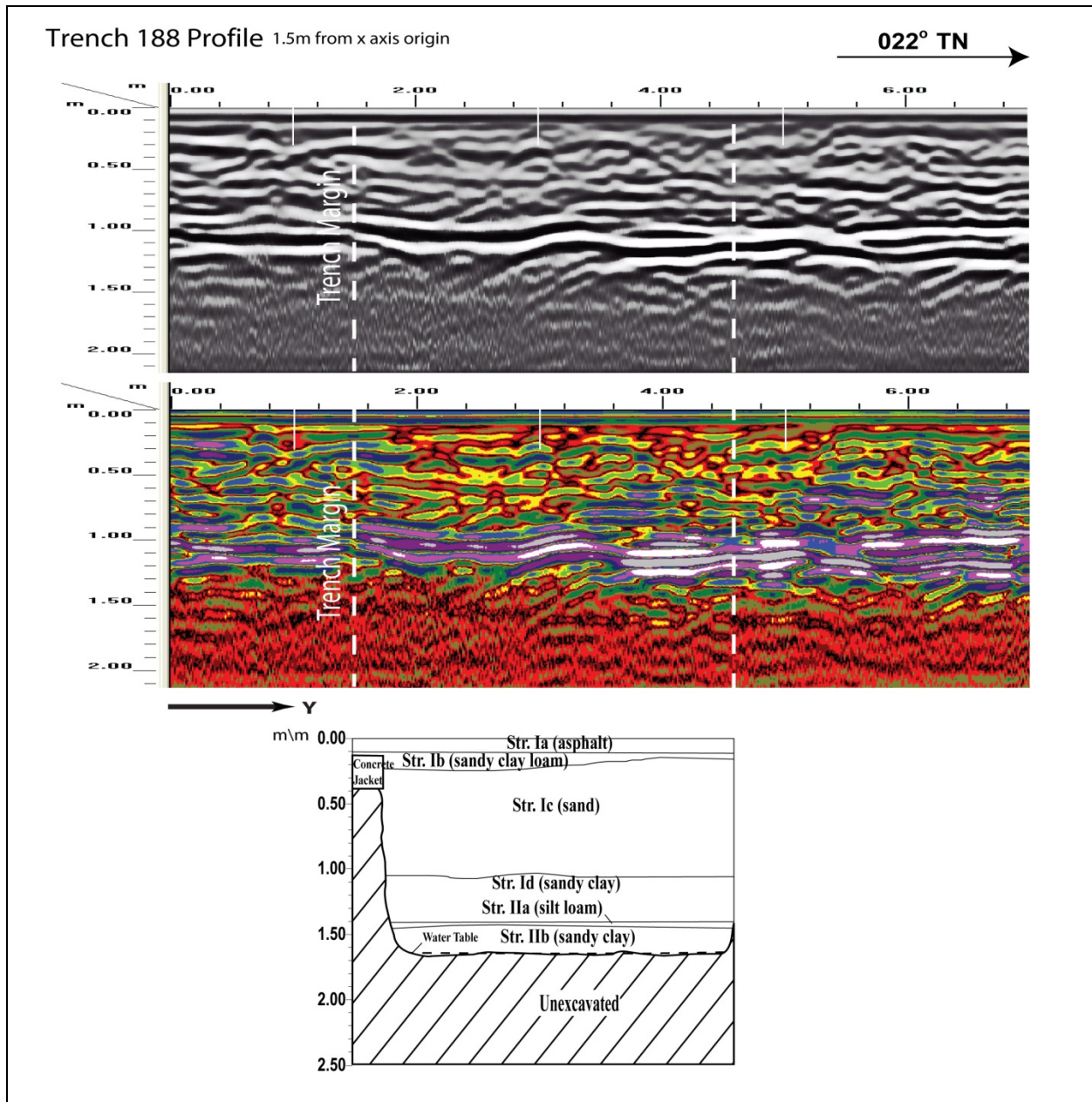


Figure 178. Visual comparison of excavated profile and GPR signal profile of T-188

## Test Excavation 189

T-189 measured 0.9 m by 3 m and was oriented northeast to southwest and was located within a parking lot at Island Pool & Spa Supply, 23 m southwest of Kona Street and Pensacola Street intersection. The GPR grid measured 3 m by 7 m with 25 cm spacing between Y-transects and 1 m spacing between X-transects. According to PB CADD, there were no utilities within close proximity of the excavation. No utilities transected the GPR grid or excavation location.

A review of amplitude slice maps indicated no linear features which might indicate the presence of utilities. Reflectivity was relatively uniform throughout the grid. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.5 mbs (Figure 179).

GPR depth profiles for T-189 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 180). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.25 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 1.3 mbs.

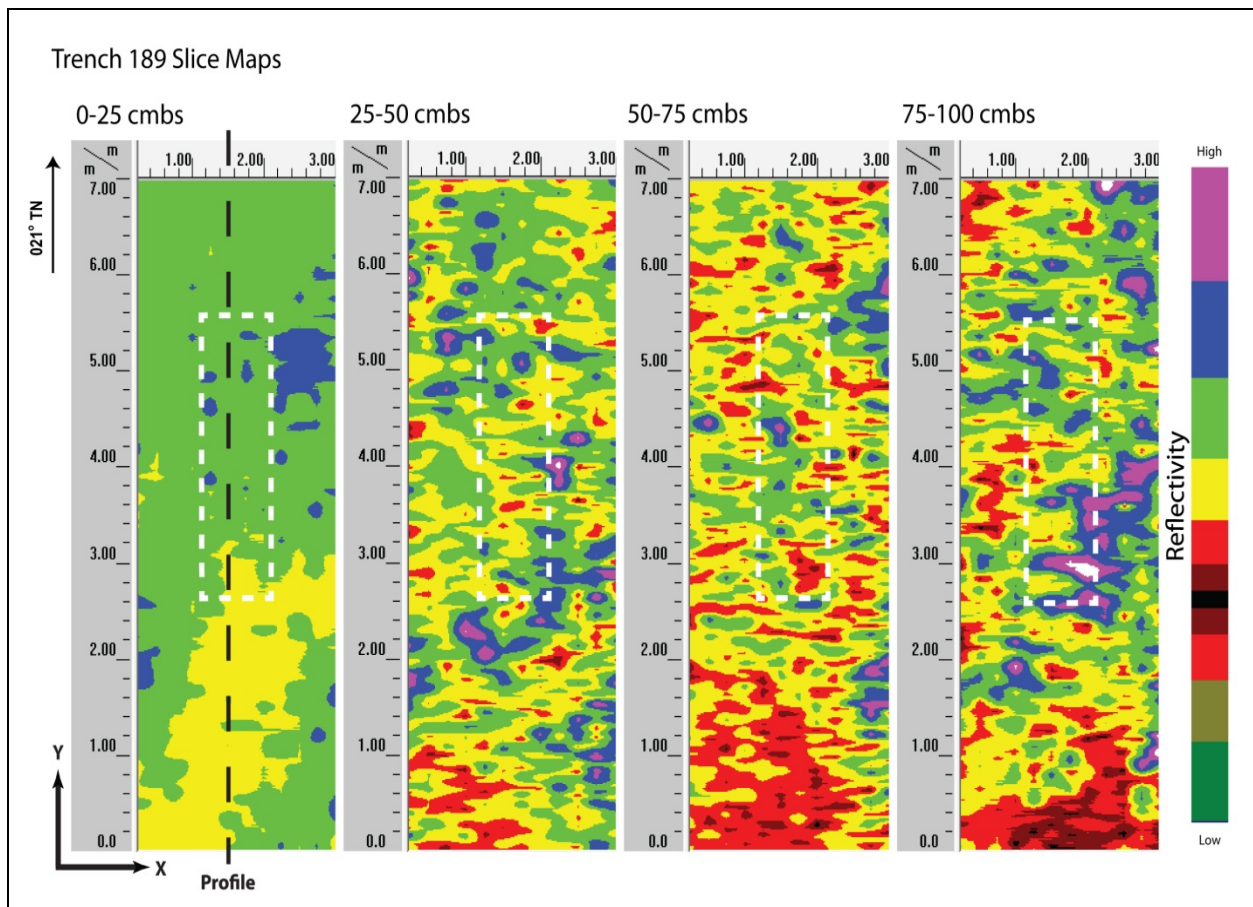


Figure 179. Slice maps of T-189 at 25 cm depth intervals



A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 180). Strata Ia through Ic were clearly observed and occurred at the ground-truthed depths. Textural changes in the form of multiple small hyperbolas were apparent in Stratum Ic which was crushed coral. All other sediment transitions were below the maximum clean signal return depth. No discrete objects were observed in the GPR results or subsequent excavation.

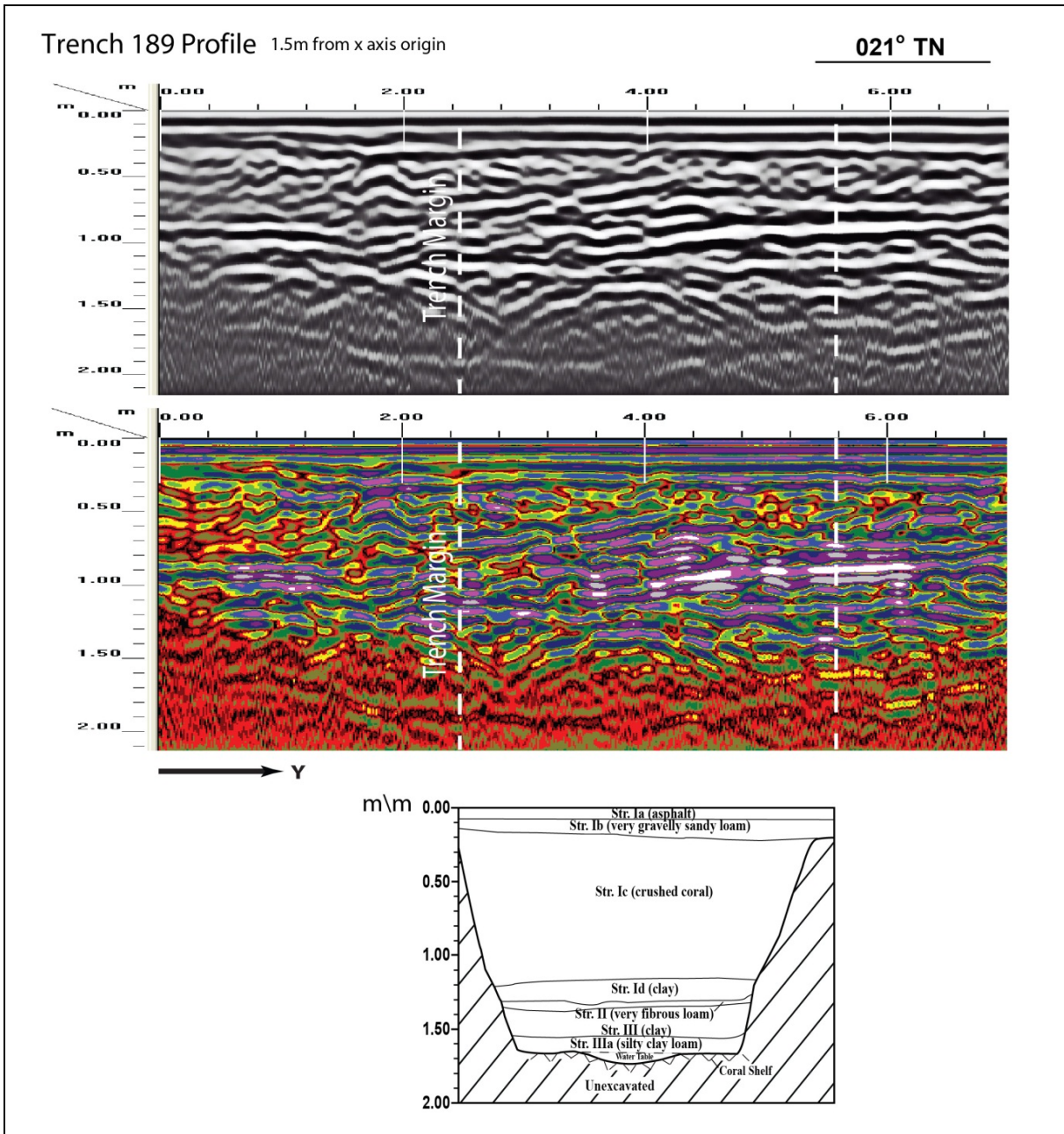


Figure 180. Visual comparison of excavated profile and GPR signal profile of T-189

## Test Excavation 190

T-190 measured 0.6 m by 6 m and was oriented northeast to southwest and was located within a sidewalk parallel to Pensacola Street, 25 m southwest of Kona Street and Pensacola Street intersection. The GPR grid measured 2.5 m by 10 m with 25 cm spacing between Y-transects and 1 m spacing between X-transects. Utilities located near the excavation include water drain 2.2 m east. No utilities transected the excavation location.

A review of amplitude slice maps indicated a linear feature but not within excavation boundaries. Reflectivity was relatively uniform throughout the grid and decreased with depth except for the linear feature. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.25 mbs (Figure 181).

GPR depth profiles for T-190 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 182). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.2 mbs and again around 0.5 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 1.2 mbs.

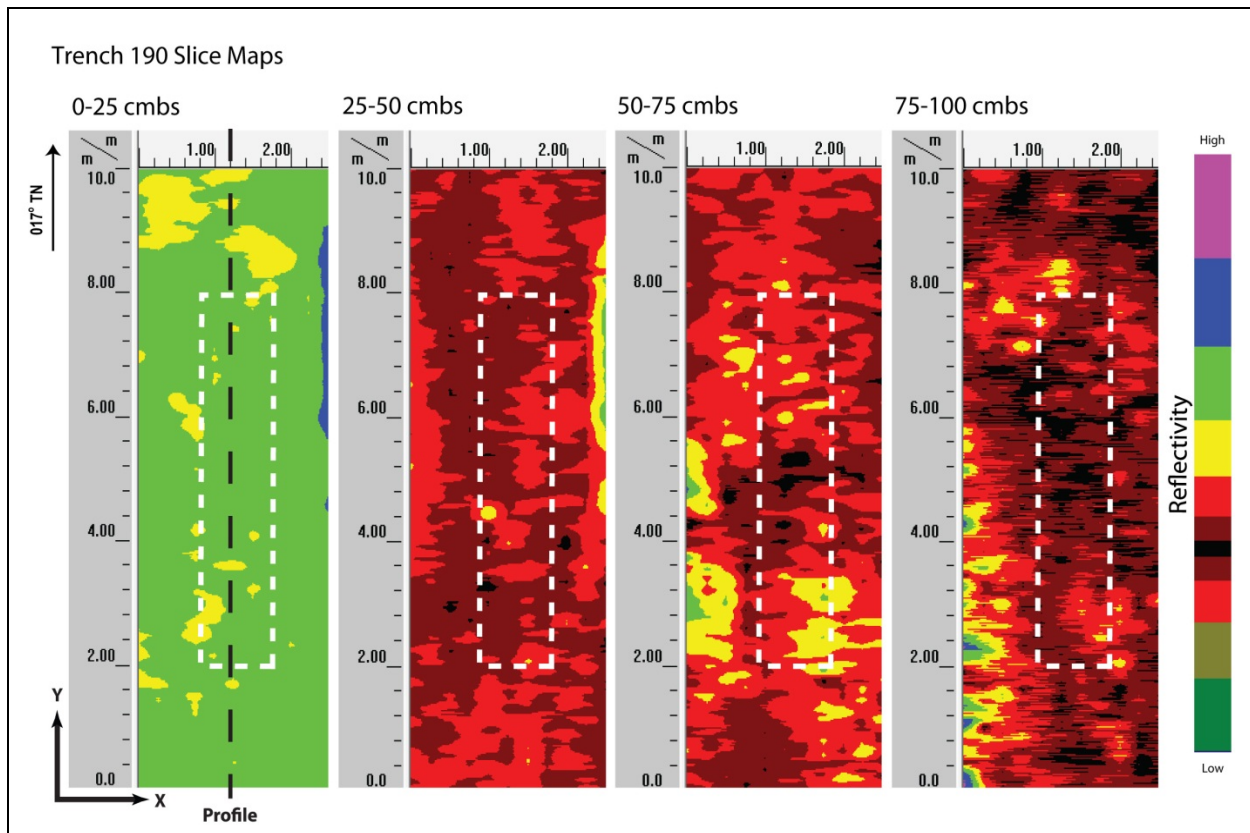


Figure 181. Slice maps of T-190 at 25 cm depth intervals



A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 182). Strata Ia through If were clearly observed and occurred at the ground-truthed depths. Stratum Ic was difficult to discern due to how it was situated between the other strata and because it was less than 0.1 m thick. All other sediment transitions were below the maximum clean signal return depth. No discrete objects were observed in the GPR results or subsequent excavation.

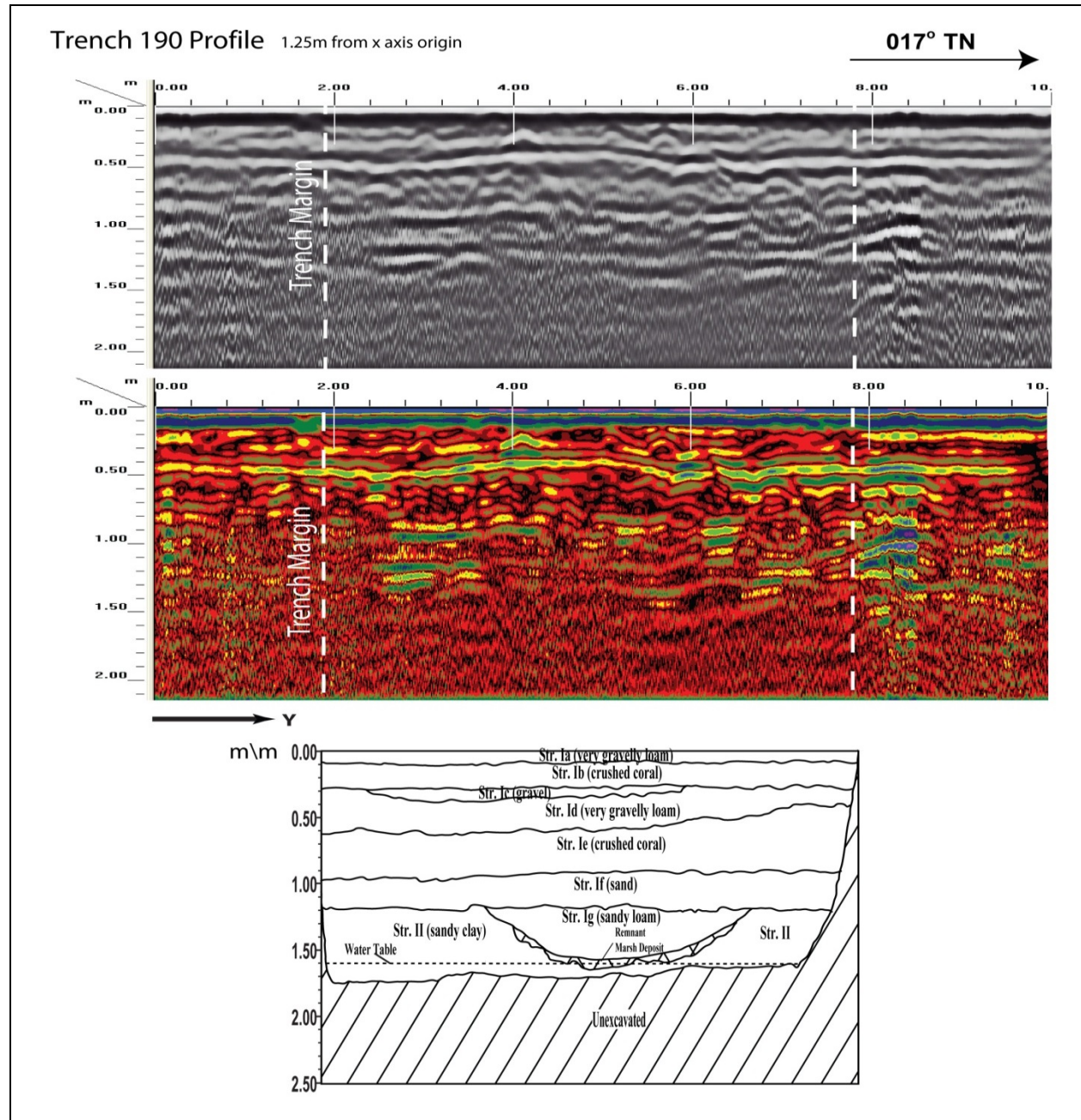


Figure 182. Visual comparison of excavated profile and GPR signal profile of T-190



## Test Excavation 191

T-191 measured 1 m by 3 m and was oriented northwest to southeast and was located within the road cut of Kona Street, 12 m west of Kona Street and Pensacola Street intersection. The GPR grid measured 2 m by 9 m with 25 cm spacing between Y-transects and 1 m spacing between X-transects. Utilities located near the excavation include water line 1.6 m south, electrical line 1.9 m north, sewer line 3 m north. No utilities transected the excavation location.

A review of amplitude slice maps indicated a linear feature but was not encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.75 mbs (Figure 183).

GPR depth profiles for T-191 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 184). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.15 mbs and again around 0.8 mbs. An anomaly was observed in the profile but was not observed during excavation. The maximum depth of clean signal return was approximately 1.1 mbs.

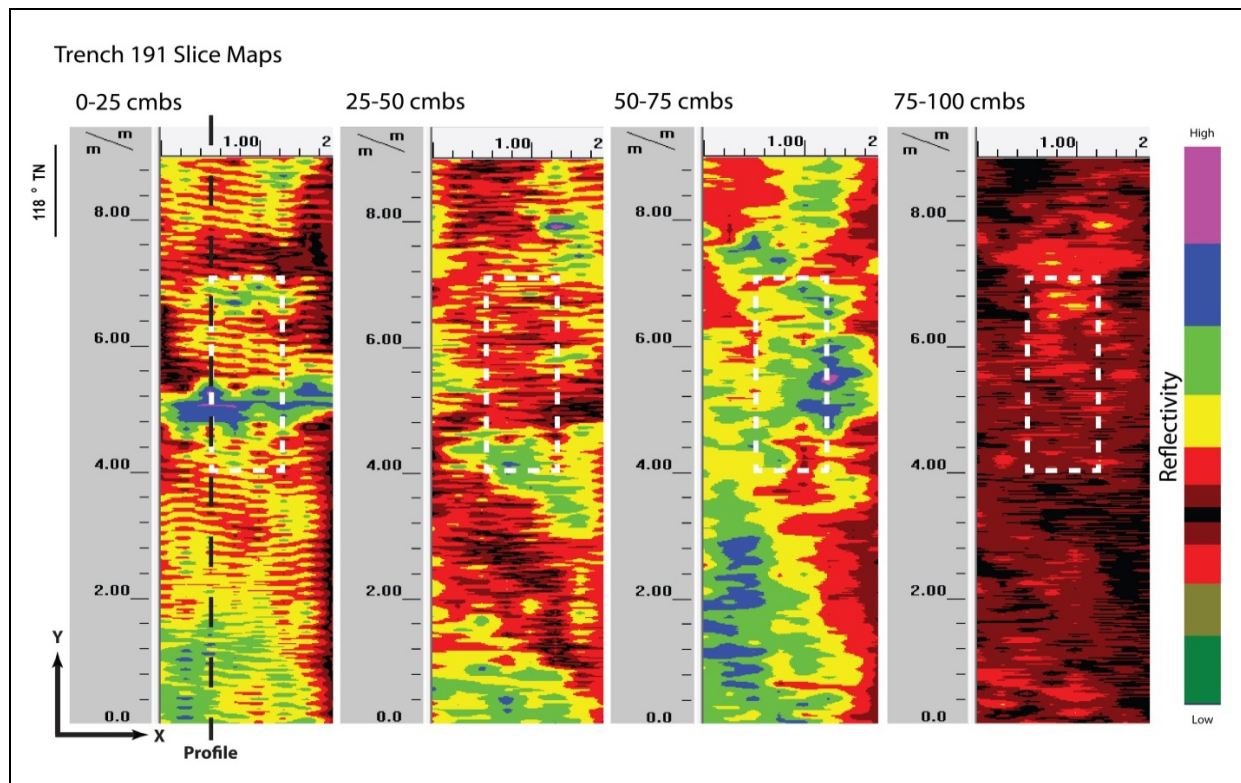


Figure 183. Slice maps of T-191 at 25 cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 184). Strata Ia to IIa were clearly observed and occurred at the ground-truthed depths. Stratum Ic was difficult to discern due to how it was situated between the other strata and because it was less than 0.1 m thick. All other sediment transitions were below the maximum clean signal return depth. No discrete objects were observed in the GPR results or subsequent excavation.

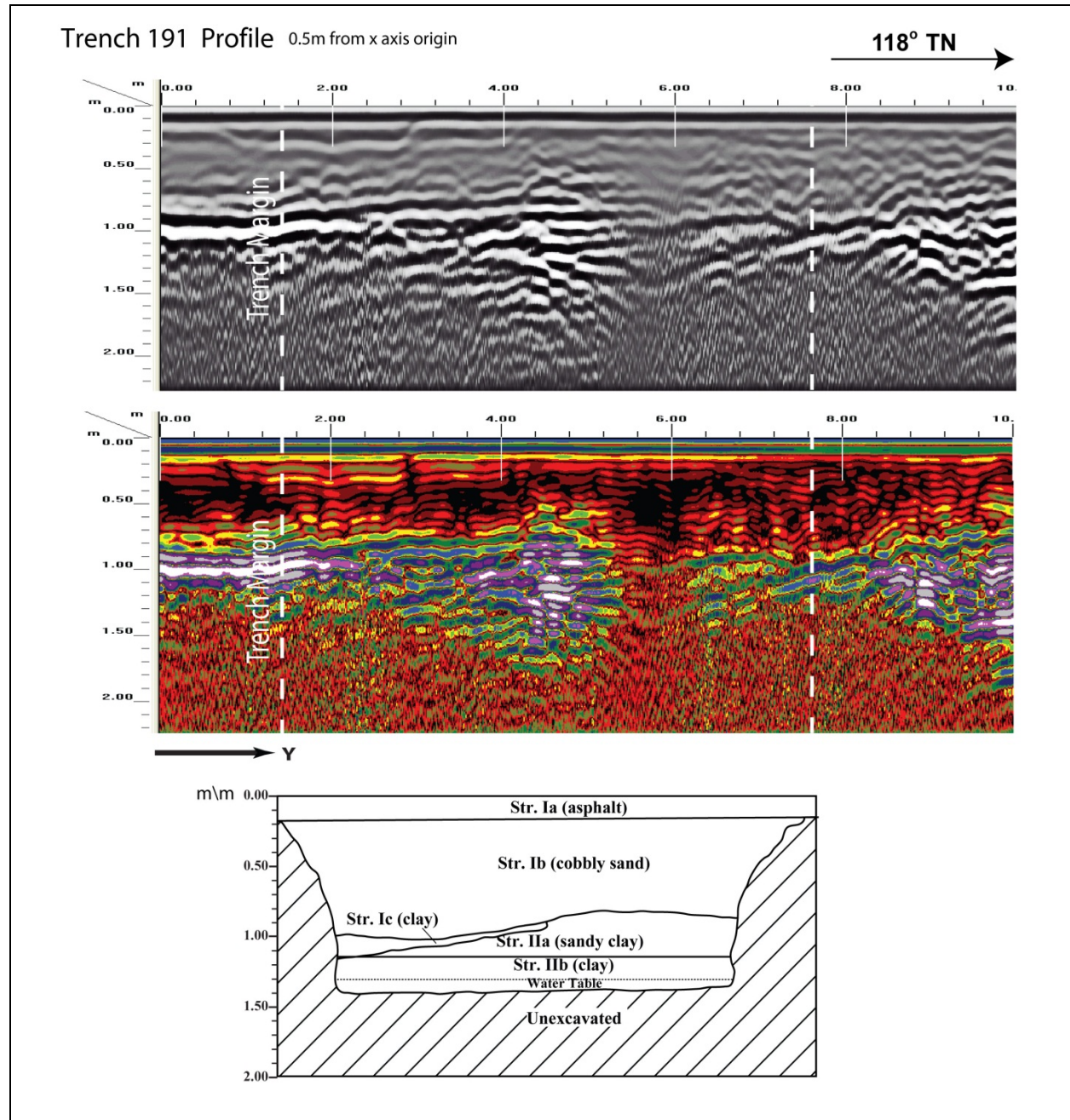


Figure 184. Visual comparison of excavated profile and GPR signal profile of T-191

## Test Excavation 192

T-192 measured 0.9 m by 3 m and was oriented northwest to southeast and was located within the road cut of Kona Street, 22 m southeast of Pensacola Street and Kona Street intersection. The GPR grid measured 3 m by 10 m with 25 cm spacing between Y-transects and 1 m spacing between X-transects. Utilities located near the excavation include gas line 0.2 m west, water line 0.8 m south, sewer line 1.2 m north. A PVC utility pipe was encountered 0.15 mbs in the northwest end of the excavation

A review of amplitude slice maps indicated linear features but not within excavation boundaries but a utility was encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth except for the linear features. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.25 mbs and increases again around 0.75 mbs (Figure 185).

GPR depth profiles for T-192 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 186). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.2 mbs. Anomalies were observed in the profile but not within excavation boundaries although a utility pipe was encountered during excavation. The maximum depth of clean signal return was approximately 1.0 mbs.

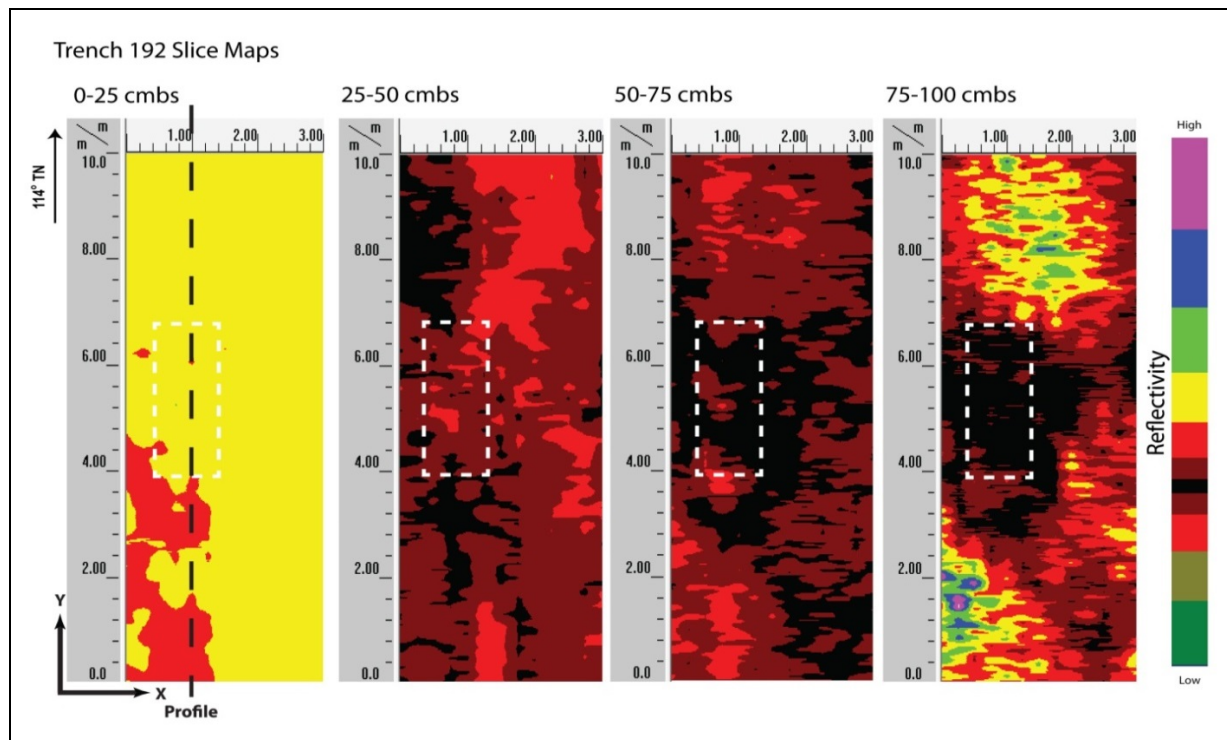


Figure 185. Slice maps of T-192 at 25 cm depth intervals



A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 186). Strata Ia to Ic were clearly observed and occurred at the ground-truthed depths. Stratum Ib was difficult to discern due to the fact that it was less than 0.1 m thick and very similar to Stratum Ic. A PVC pipe was found 0.15 mbs. This pipe did not show up on the profile or slice maps. This may be due to the fact that the pipe was comprised of PVC, that the pipe was empty or the pipe could have had a similar density to the surrounding stratum. All other sediment transitions were below the maximum clean signal return depth. No other discrete objects were observed in the GPR results or subsequent excavation.

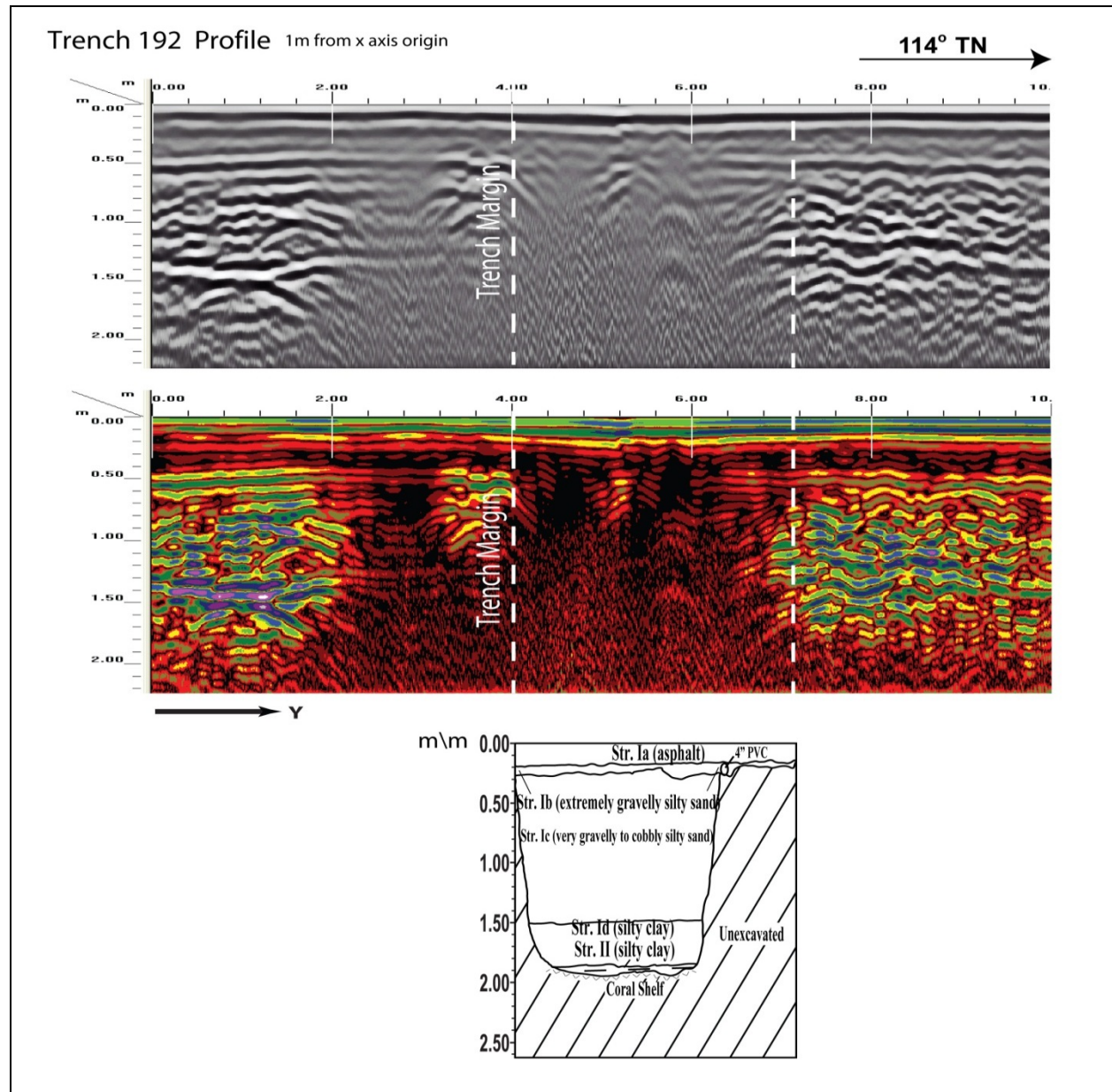


Figure 186. Visual comparison of excavated profile and GPR signal profile of T-192

## Test Excavation 193

T-193 measured 0.6 m by 6 m and was oriented northwest to southeast and was located within the road cut of Kona Street, 72 m southeast of Kona Street and Pensacola Street intersection. The GPR grid measured 2.5 m by 10 m with 25 cm spacing between Y-transects and 1 m spacing between X-transects. Utilities located near the excavation include water line 1.3 m north, gas line 2.8 m east, electrical line 6.6 m north. A gas utility line was encountered 0.4 mbs along the entire southwest wall of the excavation.

A review of amplitude slice maps indicated no linear features although a utility was encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.25 mbs and increases again around 0.75 mbs (Figure 187).

GPR depth profiles for T-193 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 188). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.2 mbs and again at 0.7 mbs. An anomaly was observed in the profile but was not encountered during excavation but a gas utility was encountered during excavation. The maximum depth of clean signal return was approximately 1.6 mbs.

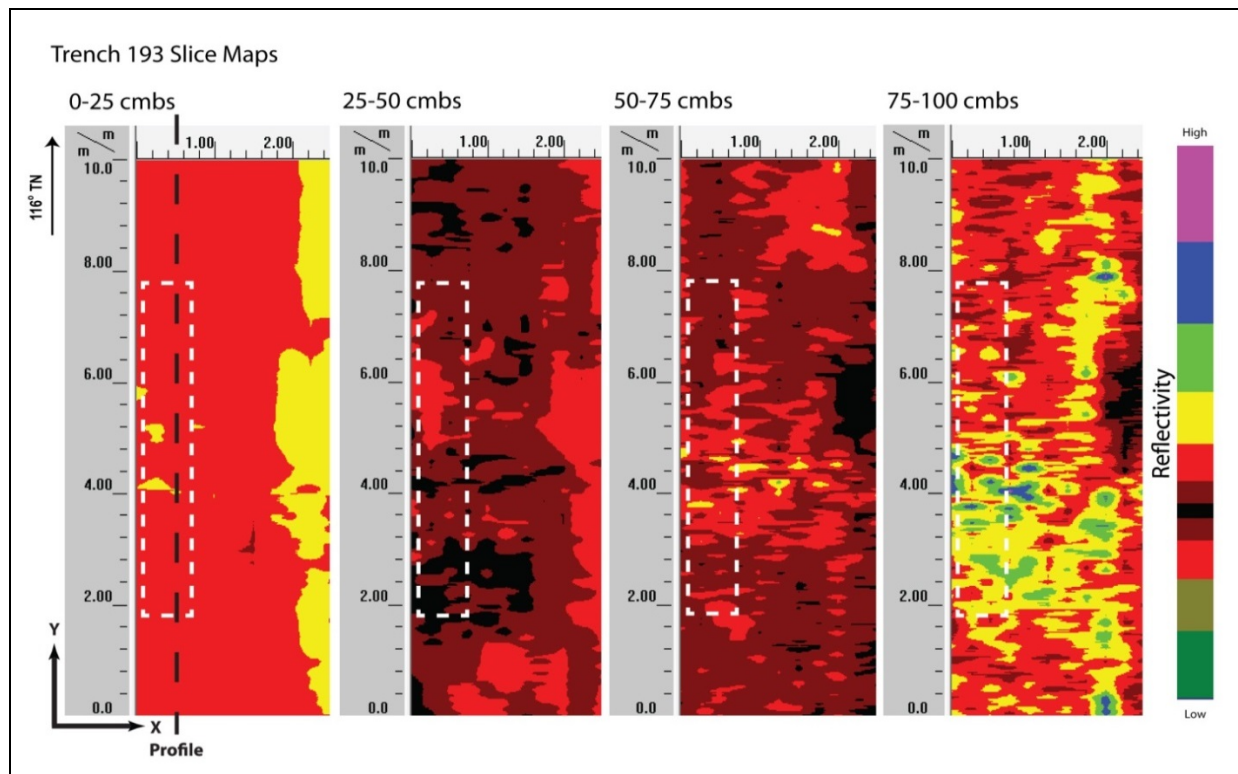


Figure 187. Slice maps of T-193 at 25 cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a moderate correlation in stratigraphic transitions (Figure 188). Strata Ia to Id were clearly observed and occurred at the ground-truthed depths. A gas line was found 0.4 mbs. This gas line did not show up on the profile or slice maps. All other sediment transitions occurred below the maximum clean signal return depth. No other discrete objects were observed in the GPR results or subsequent excavation.

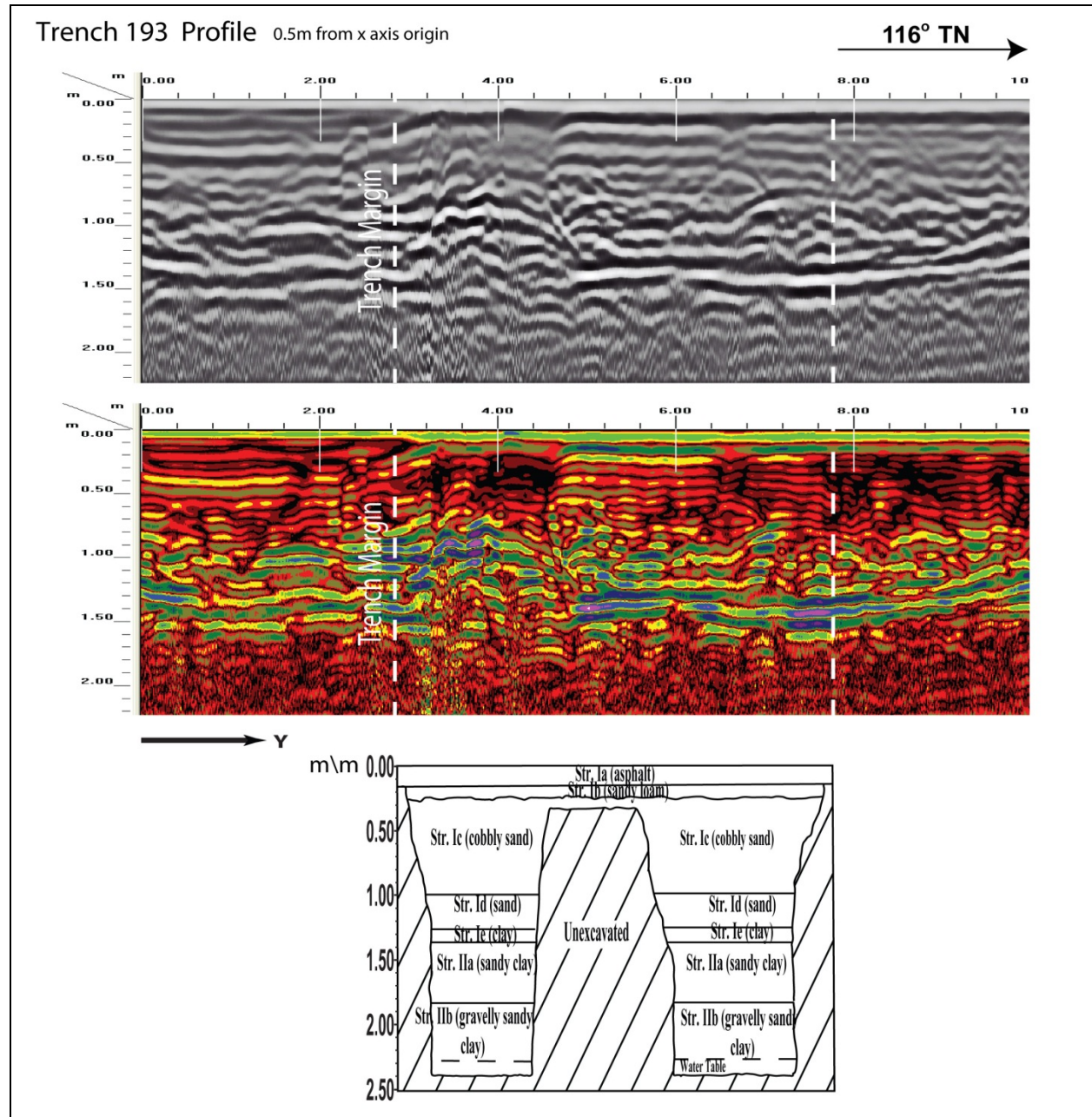


Figure 188. Visual comparison of excavated profile and GPR signal profile of T-193



## Test Excavation 194

T-194 measured 0.9 m by 3 m and was oriented northwest to southeast and was located within the road cut of Kona Street, 55 m northwest of Piikoi Street and Kona Street intersection. The GPR grid measured 2.5 m by 7 m with 25 cm spacing between Y-transects and 1 m spacing between X-transects. Utilities located near the excavation include water line 1 m south, gas line 2.5 m southeast, electrical line 2.3 m northeast. A metal utility pipe was encountered 0.4 through the center of the excavation and a concrete jacket was encountered 0.9 mbs along the entire length of the excavation.

A review of amplitude slice maps indicated linear features one outside of excavation boundaries and the other seems to corresponded to the metal utility encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth except for the linear features. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.25 mbs (Figure 189).

GPR depth profiles for T-194 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 190). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.4 mbs. Anomalies were observed in the profile and one corresponded to the metal utility encountered and the other was below the concrete jacket and was not able to be ground-truthed. The maximum depth of clean signal return was approximately 1.3 mbs.

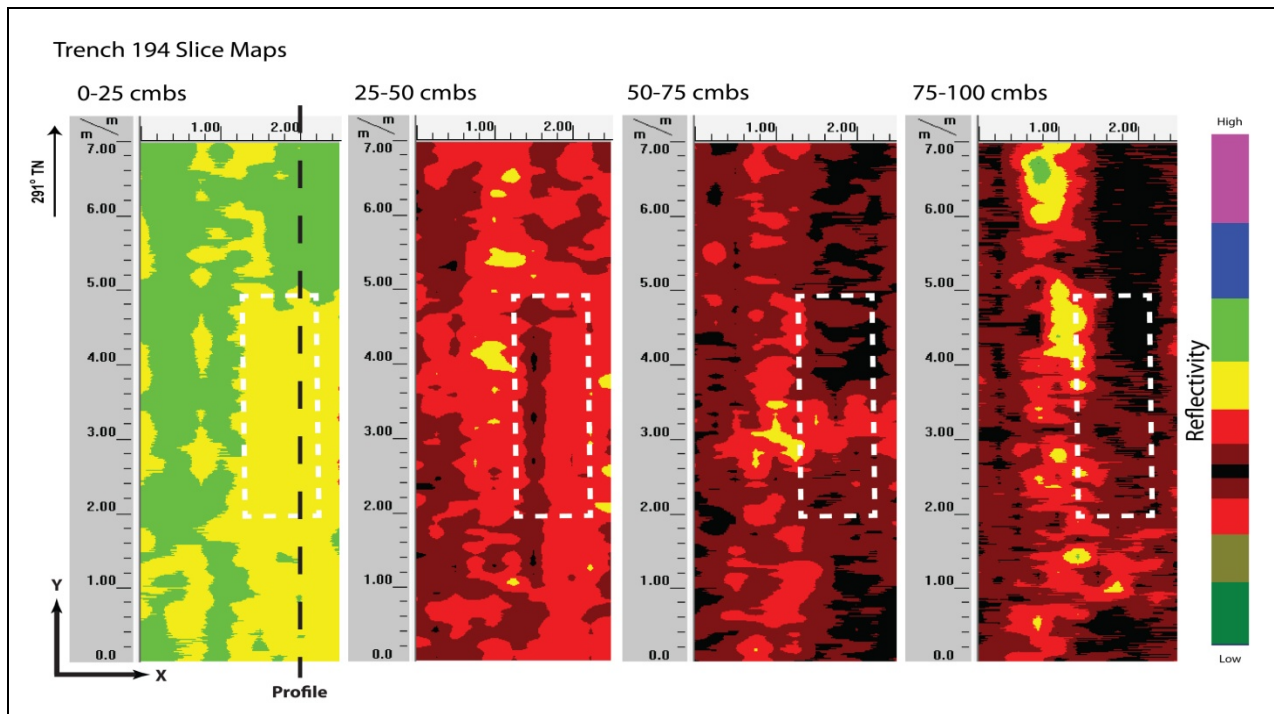


Figure 189. Slice maps of T-194 at 25 cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 190). Strata Ia to Id were clearly observed and occurred at the ground-truthed depths. Stratum Id was difficult to discern due to it being less than 0.1 m thick. A utility pipe and concrete jacket were found 0.4 and 0.9 mbs, respectively. An anomaly was observed in the profile that corresponded to the utility pipe. The concrete jacket did not show up on the profile or slice maps. This may be due to the fact that the concrete was not reinforced with steel (rebar) or that it was a similar density to the surrounding stratum. No other discrete objects or stratigraphic transitions were observed in the GPR results or subsequent excavation.

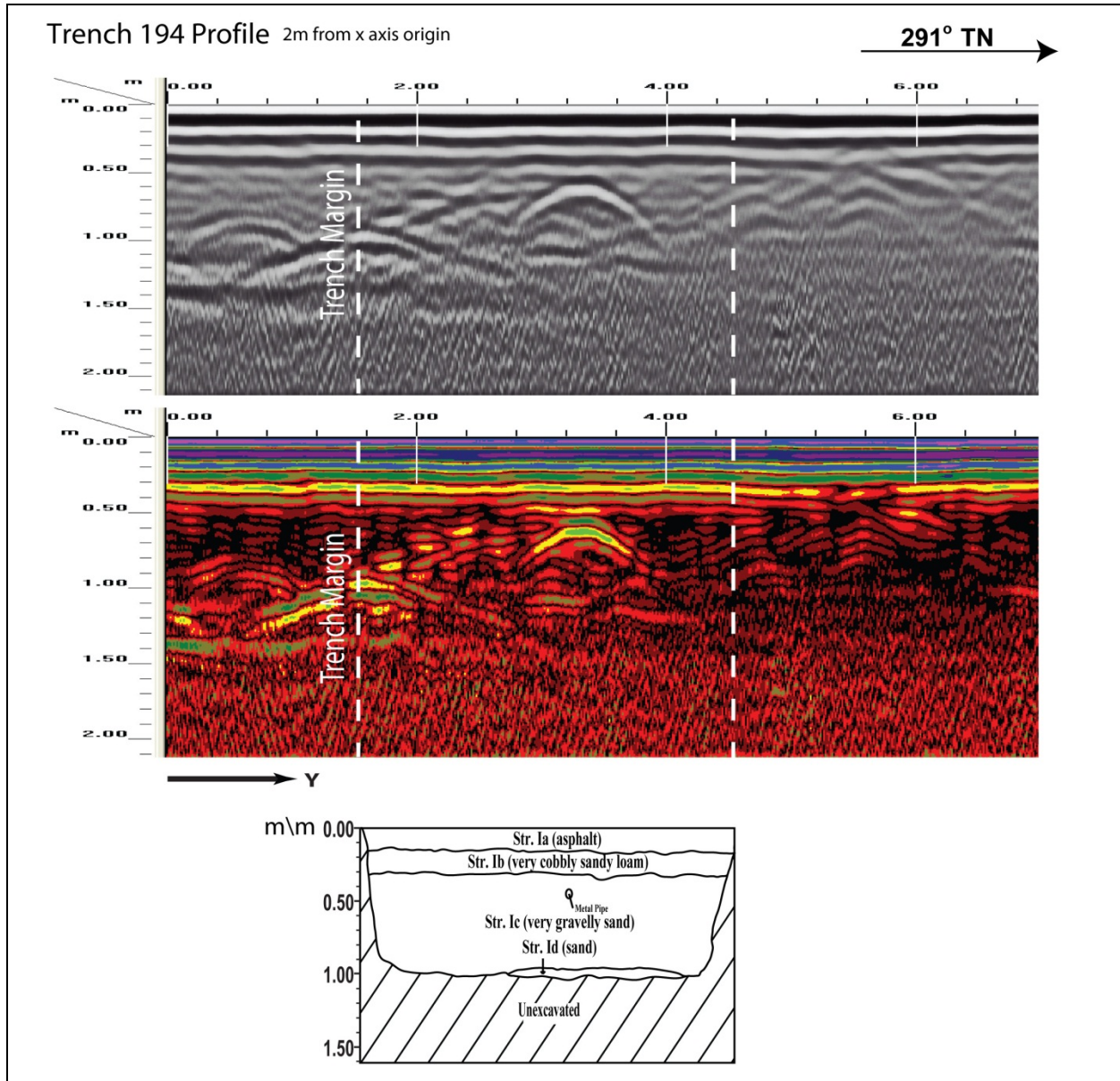


Figure 190. Visual comparison of excavated profile and GPR signal profile of T-194

## Test Excavation 195

T-195 measured 0.9 m by 4 m and was oriented northwest to southeast and was located within the parking lot at Island Pool & Spa Supply, 45 m southwest of Kona Street and Pensacola Street intersection, within a parking lot. The GPR grid measured 3 m by 7 m with 25 cm spacing between Y-transects and 1 m spacing between X-transects. According to PB CADD, there were no utilities within close proximity of the excavation. A utility jacket was encountered approximately 0.1 mbs in the western end of the excavation.

A review of amplitude slice maps indicated a linear features which could corresponded to the utility jacket encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.5 mbs (Figure 191).

GPR depth profiles for T-195 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 192). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.1 mbs. An anomaly was observed in the profile and corresponded to the utility jacket encountered during excavation. The maximum depth of clean signal return was approximately 1.0 mbs.

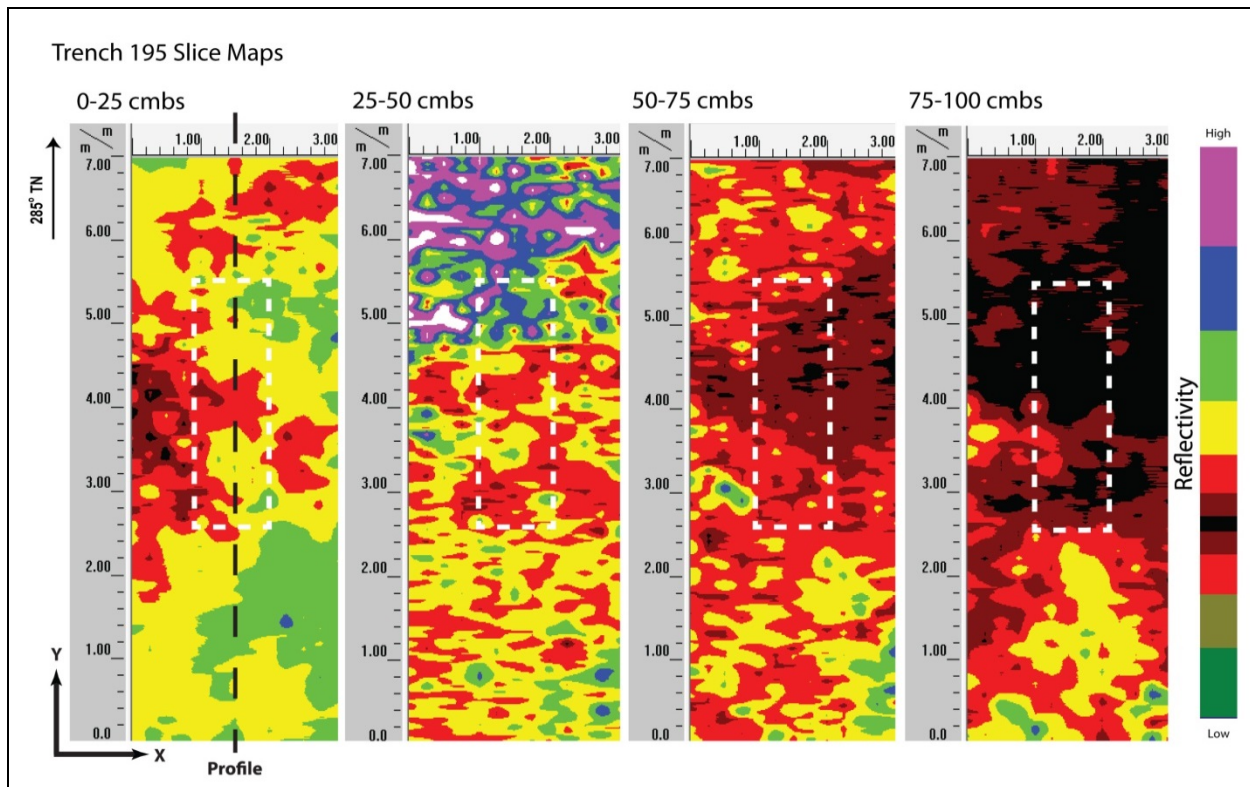


Figure 191. Slice maps of T-195 at 25 cm depth intervals



A visual comparison of the excavated profile and the GPR signal profile showed a weak correlation in stratigraphic transitions (Figure 192). Strata included, from top to bottom, asphalt, clay loam fill, crushed coral, clay fill, clay fill, and natural clay loam. These transitions were not clearly depicted in the GPR profile at the depths that they occurred. A utility jacket was found 0.1 mbs. A void was observed in the profile and corresponded to the utility jacket. No other discrete objects were observed in the GPR results or subsequent excavation.

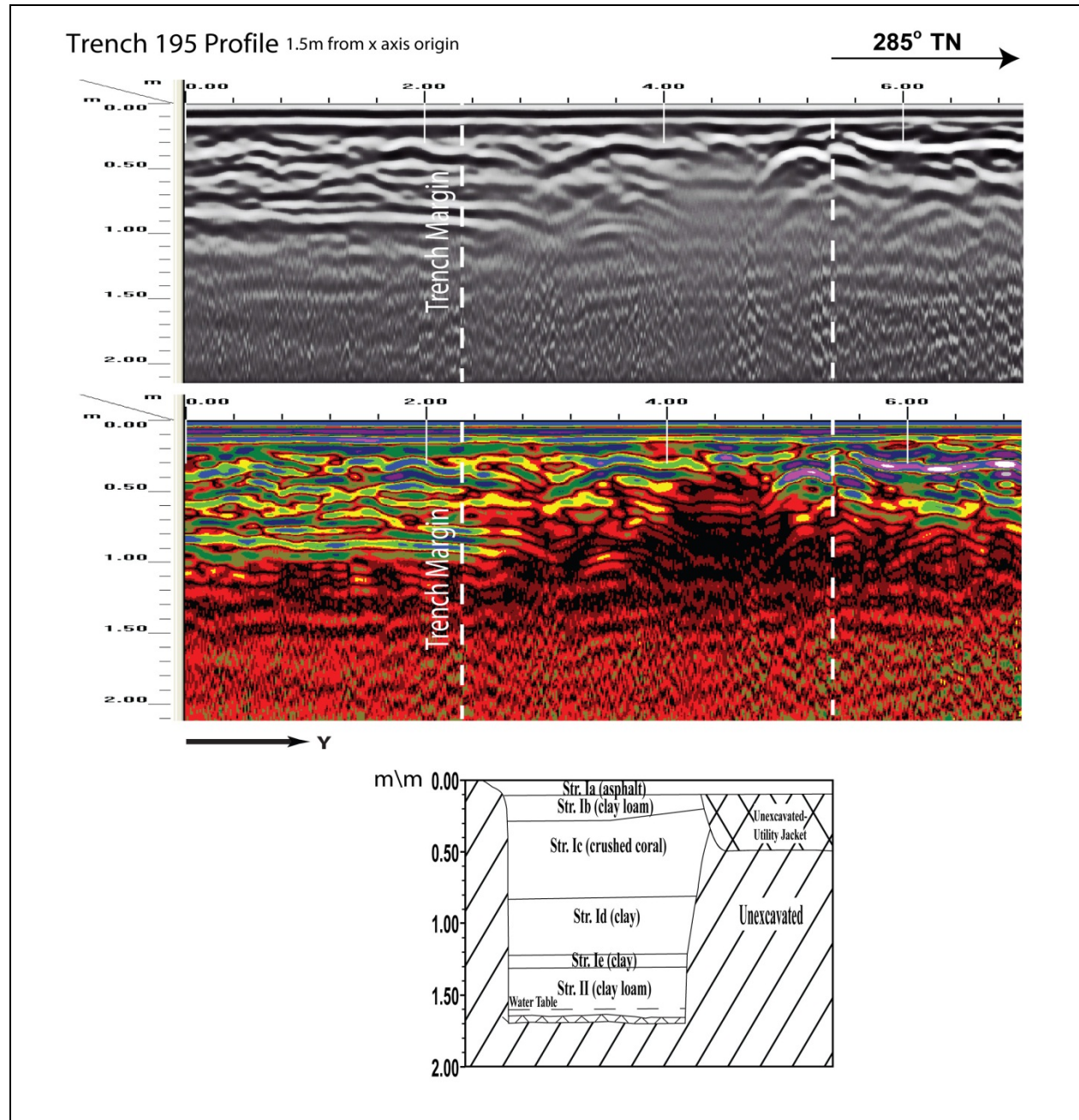


Figure 192. Visual comparison of excavated profile and GPR signal profile of T-195

## Test Excavation 196

T-196 measured 0.7 m by 3 m and was oriented northwest to southeast and was located within the road cut of Kona Street, 15 m west of Kona Street and Pi'ikoi Street intersection. The GPR grid measured 3 m by 7 m with 25 cm spacing between Y-transects and 1 m spacing between X-transects. Utilities located near the excavation include water line 10 cms southwest, electrical line 2.1 m northeast. No utilities transected the excavation location.

A review of amplitude slice maps does indicate a linear feature that was indicative of a water main running parallel to the excavation but was not encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.5 mbs (Figure 193).

GPR depth profiles for T-196 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 194). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.25 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 1.0 mbs.

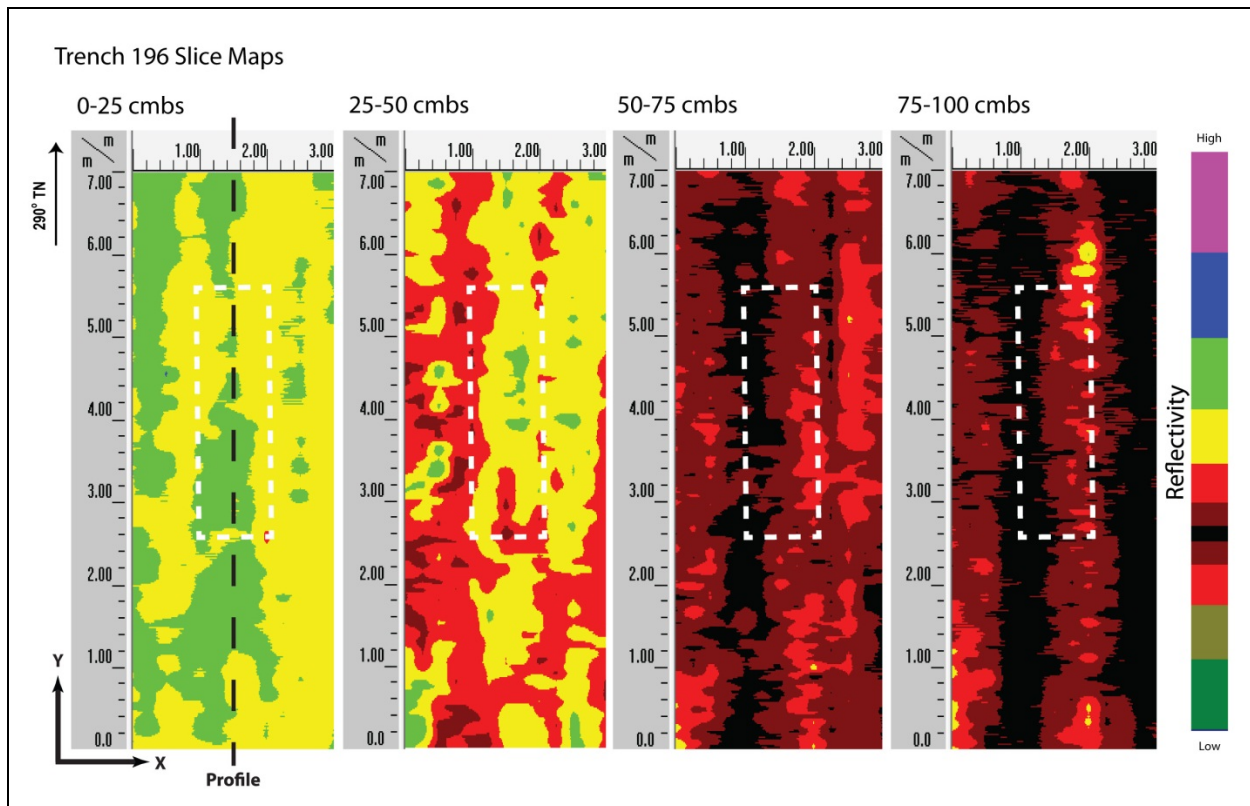


Figure 193. Slice maps of T-196 at 25 cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 194). Strata Ia to Ic were clearly observed and occurred at the ground-truthed depths. Textural changes in the form of multiple small hyperbolas were apparent in Stratum Ic which was gravelly sand. All other sediment transitions were below the maximum clean signal return depth. No discrete objects were observed in the GPR results or subsequent excavation.

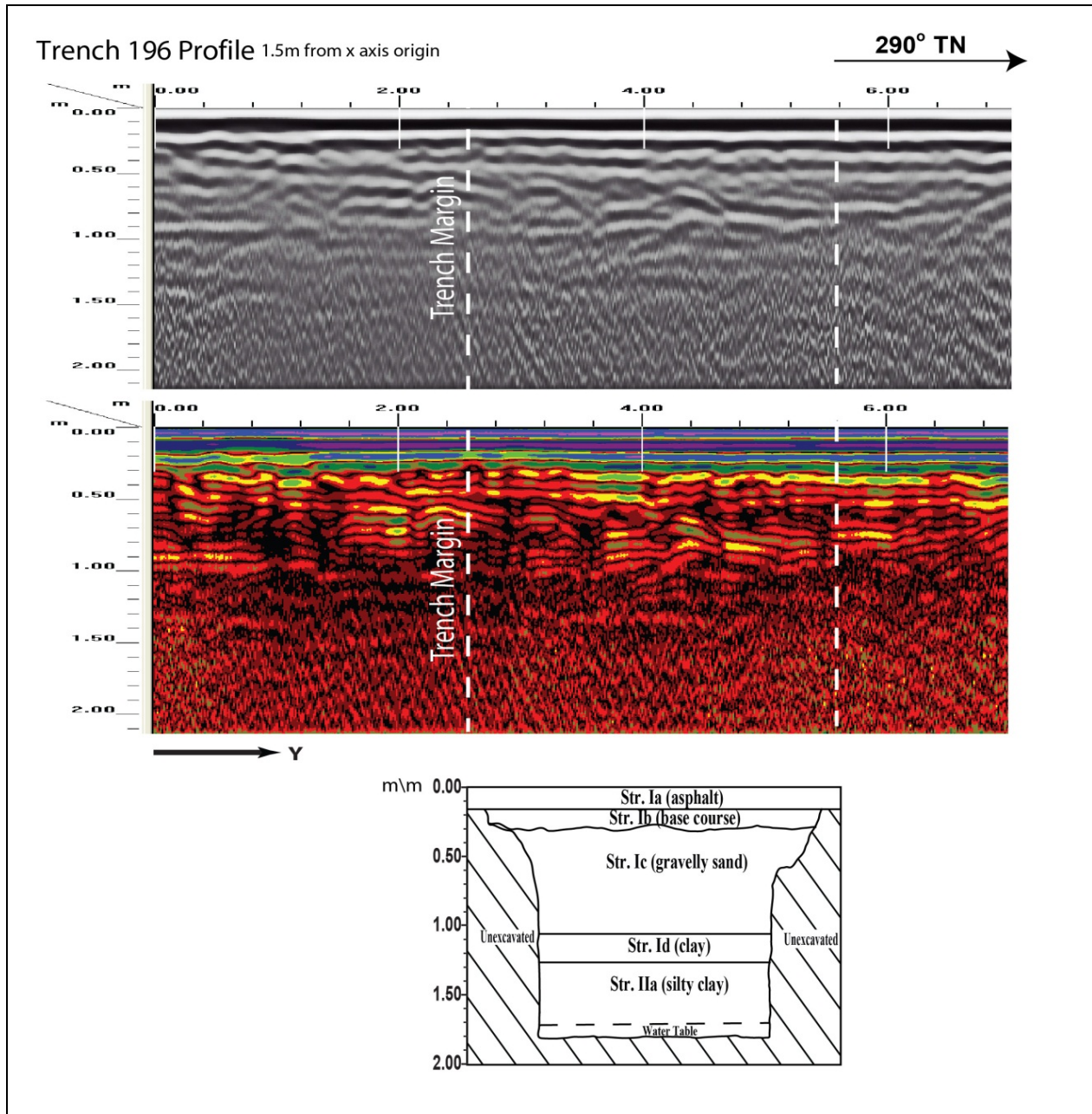


Figure 194. Visual comparison of excavated profile and GPR signal profile of T-196